

This book gives a detailed classification of Mosses under the Division Bryophyta. All orders found in India are listed and described.

The life cycle of a moss; collection and preservation of mosses and methods of classification are described in the introductory chapter. Preparing museum specimens or permanent slides is an aspect of interest to moss collectors.

The text comprises one hundred genera—which are illustrated in 50 colour plates. The Identification Key is given in the Introduction and with each plate is a detailed graphic description.

Front cover:

Lyellia crispa (an endangered species) growing in tufts among weeds on Lebong Road side in Darjeeling in 1964. It has vanished from this site since.

Back cover:

The genus *Pogonatum* growing all over the Himalayas and also the West and South Indian Mountains.

HANDBOOK OF INDIAN MOSSES

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Illustrations by RANJAN DE





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FOREWORD

The mosses form one of the most remarkable groups of plants forming the initial green felt, often serving as substrate for the growth of higher plants. This group has the unique characteristics of having well developed sporophytes and gametophytes, the former being parasitic on the latter. Its economic importance as soil indicators, evolutionary significance from the viewpoint of alternating generations, and ecological preferences make it an ideal group for detailed analysis.

Unfortunately, this subcontinent though rich in moss flora has not been explored to the extent it deserves. Professor H.C. Gangulee, my colleauge and a distinguished Fellow of the Indian National Science Academy is an eminent bryologist internationally known as an authority on mosses. He has devoted the major part of his life towards exploration of the world of mosses. No scientist could have been better suited than Professor Gangulee to undertake this immensely difficult task. I am sure that this book, which bears the touch of his expertise, will meet the long felt need of such a comprehensive document on mosses and a Textbook in the Practical classes—essential for undergraduate and postgraduate students in Botany.

A.K. SHARMA Former President, Indian National Science Academy

PREFACE

It has been my sad experience during a long period that the teaching of Bryophytes is badly neglected in most of the Indian Universities mainly because there is no book for the identification and description of the common Indian taxa. Things are much better for the Hepatics because of the Monograph by the late Prof. S.R. Kashyap on the Western Himalayan Liverworts which is extremely helpful for a knowledge of the Indian species. But. in the vast field of the Indian mosses the teachers and the students are at a loss as there is no book which can render easy handling of this group. This author's Monograph on the Mosses of Eastern India is too voluminous to be used by the general student. Therefore, this Handbook of Indian Mosses has been prepared to serve as a simple textbook and a guide book for the advanced Botany practical classes. One hundred representatives from one. hundred genera are described and illustrated in colour here. It may not be possible to get the class material for all these genera but even if a good number of them are learnt and seen in the practical class, it would familiarise the postgraduate Botany students to this beautiful group of plants. Even in the graduate classes this book should be used as a guide. The illustrations have been rendered in colours which are as natural as it can be considering the limitations.

The author would be gratified if, in future, this book proves its usefulness and be appreciated by the teachers and the students. It can then be dreamt that one day, as in moss-loving Japan, there would be gardens and temples on the Himalayas and the Nilgiris in whose layout mosses would take their due share:

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The author expresses his gratitude to the University Grants Commission at whose initiative the work was taken up and who gave financial aid for the preparation of the manuscript. The author is also grateful to Prof. A.K. Sharma and the Department of Botany for giving all facilities for the work. Thanks are also due to Shri Ranjan De for preparing the illustrations. Grateful thanks to the National Book Trust for subsidising the publication so that the price of the book remains within the reach of the students.

H.C. GANGULEE

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Introduction

As this is a Handbook meant for College and University students, there is no need to explain what is a Bryophyte or a moss or what is alternation of generations. One should know at this stage why a 'fern' of a very diminutive type is not a 'moss'. But, it is necessary to stress some salient features.

In classifying the plant kingdom, certain very meaningful terms have been coined during the last two hundred years. Thus we have the terms 'land plants', 'archegoniatae', 'cormophyta', 'embryophyta' etc. and the Bryophytes are no doubt components of all these groups. But, in a modern scientific classification all such terms have to be standardised and hence, we have the International Association for Plant Taxonomy & Nomenclature to codify all terminologies. They have ruled that the Plant Kingdom should be divided into a number of 'Divisions' each ending in the suffix '-phyta'. The Plant Kingdom may clearly be divided into four divisions which are marked by their distinctive type of alternation of generations as follows:

I. Division THALLOPHYTA. This is a complex group of the simplest plants (the bacteria, the algae, the fungi and so forth) which do not show any uniform or clear cut *alternation of generations* as this feature was still in the stage of evolution. The group is so complex that Taxonomists have shown that, in actuality, it is not a single Division but a Division-complex.

Clear and fixed alternation, of generations is found in the three following Divisions (Fig. 1):

- II. Division BRYOPHYTA. They show a life cycle in which the main plant is a haploid gametophyte while the diploid gametophyte is a parasite on it.
- III. Division PTERIDOPHYTA. Here the gametophyte is a comparatively delicate but, yet, independent plant. The sporophyte is the independent, strong, main plant. So, the main point is that both the generations are independent of one another.
- IV. Division SPERMAPHYTA. Here the case is the reverse of Bryophyta. The main plants are strong independent sporophytes as in the Pteridophytes while the gametophytes are insignificant parasites on them.

The moss

Moss belongs to the Division Bryophyta. This Division is divided into three *classes* ending in the suffix *-psida* (again, according to International Rules) (1) Hepaticopsida (the common Liverworts like *Riccia* and *Marchantia*), (2) Antocerotopsida (*Anthoceros* and *Notothylas* which are distinct from the common Liverworts by their typical sporophytes), and (3) Bryopsida which are the Mosses.

The life cycle of a moss (Fig. 2) must already be known to all College students. The main plant is the gametophyte which is mostly rather delicate though some sturdy forms are also known. Some of these trail on soil, rock or wood and may be fixed by rhizoids to the substratum. The smaller, commoner ones are small, erect plants which are often gregarious, forming tufts. The gametophyte may propagate vegetatively by proliferation or by developing gemmae. At a favourable time and locality the sex organs (antheridia and archegonia) develop on the gametophytes and ultimately

fertilisation results into an embryo. This embryo develops the sporophyte which is parasitic on the gametophyte. It may be noted that we talk of leaves and stems of the moss gametophyte. But, 'leaf' and 'stem' are organs of the sporophyte and similar organs on the gametophyte should have other names. The suggested terms *phyllid* and *caulid* are very appropriate. The seta of the sporophyte can, of course, be termed as a 'stem'.

The sporophyte has very definite and stable characters. So, like the flower in the flowering plants, the sporophyte is considered first in any scientific classification of the moss. Gametophytic characters are considered for distinguishing the lower taxa. In the sporophyte, the peristome structure of the capsule is the most important character to be considered. But, it is noted that even the peristome structure is sometimes variable (usually by reduction) within the same taxor. Then, the other (mostly gametophytic) characters are also to be considered. Thus, *Lyellia* and *Pogonatum*, *Physcomitrium* and *Funaria* belong to the same families (Polytrichaceae and Funariaceae) although the first of each pair shows no peristome teeth while the second shows prominent teeth — because the gametophytes match very well. Even *Archidium*, which shows a most problematic sporophyte, cannot be taken too far away from the Dicranales — because the gametophytes do not differ.

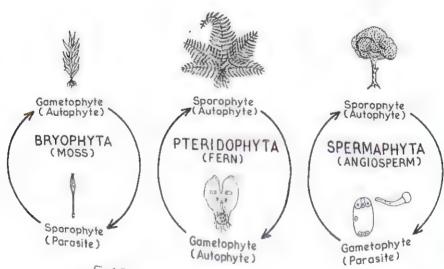


Fig 1. The alteration of generations of Bryophyta, Pteridophyta and Spermaphyta.

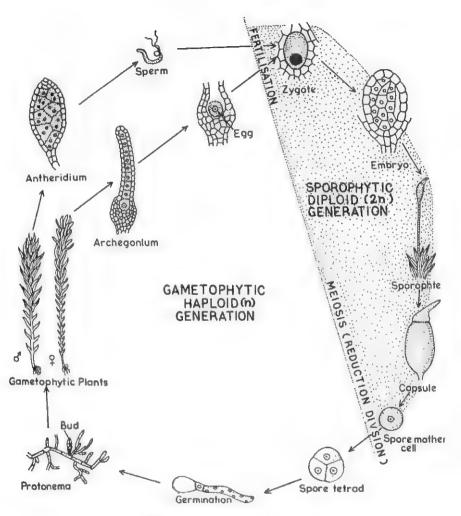


Fig2. Life cycle of a moss.

CLASSIFICATION OF MOSSES (BRYOPSIDA)

(Orders not found in India are omitted)

- As has been stated above, in the broader classification we are to consider the peristome structure first. The following classification is the most logical.
- Subclass I. SPHAGNIDAE Subaquatic, prostrate or trailing, greenish white plants. Leaf cells showing large, dead, spongy cells with fibrous thickening bordered by narrow chlorophyllous cells. Sporophyte formed of capsule and foot only but pushed up by the gametophytic pseudopodium. Peristome absent but operculum present.

Only family Sphagnaceae. Single genus Sphagnum (Plate I).

Subclass II. ANDREAEIDAE — Erect, acrocarpic, gregarious mosses on granite. Sporophyte with capsule and foot, projected by pseudopodium as in *Sphagnum*. No operculum or peristome, dehiscing by splitting into valves.

Only family Andreaeaceae, Predominant genus Andreaea (Plate I).

- Subclass III. BRYIDAE True moss. Peristome is a prominent structure but the teeth are sometimes suppressed by degeneration (except Archidiales).
- Section I. NEMA'i ODONTEAE Peristome teeth solid (Fig. 3) being formed by the compression of several concentric layers of cells.
- Order 1. **Buxbaumiales** Peristome found in two rings of which one may be missing. Families Buxbaumiaceae and Diphysciaceae (*Diphyscium* Plate II).
- Order 2. **Polytrichales** Leaves with a thick median part (which may cover most of the leaf) showing low or high longitudinal lamellae or plates of cells. Peristome teeth in a single ring or absent by degeneration (*Lyellia*).

Family Polytrichaceae is a very common Himalayan (also in other mountains) family with five genera — *Atrichum* (Plate III), *Oligotrichum*, *Pogonatum* (Plate IIII), *Polytrichum* (Plate IIII) and *Lvellia* (Plate IV).

- Section II. ARTHRODONTEAE Peristome teeth scaly (Fig. 3) being formed of the dried walls of usually 2 layers of cells.
- Series I. HAPLOLEPIDEAE Peristome teeth in one ring (peristome absent in *Archidium*). Acrocarpic (except *Racomitrium* of Grimmiaceae).
- Order 3. **Archidiales** A very peculiar acrocarpic type of moss with the sporophyte as simple as in the simpler hepatics *Riccia* or *Sphaerocarpos*, without any columella or seta. The whole endothecium is sporogenous forming only a few large spores encased within the single-layered wall formed by the amphithecium. There is no trace of peristome or even operculum and this does not seem to be due to degeneration so that some Bryologists doubt if it should not be separated from all other mosses as Astomopsida or Archidiopsida But, the gametophyte is typically like that of the Dicranales. Single family Archidiaceae with single genus *Archidium* (Plate IV).
- Order 4. Dicranales Families Ditrichaceae (Peristome variable: Garckea Plate V), Dicranaceae (Peristome teeth split into two: Trematodon Plate V, Wilsoniella & Dicranella Plate VI, Campylopodium & Campylopus Plate VII, Symblepharis & Dicranum Plate VIII) and Leucobryaceae (greenish white plants showing chlorocyst and leucocyst cells in leaves: Leucobryum & Octoblepharum Plate IX).
- Order 5. **Fissidentales** Peristome teeth dicranate. Leaves districtions with sheathing lamini. Single family Fissidentaceae. Conspicuous genus *Fissidens* (Plate X) of which 82 species occur in India.
- Order 6. Syrrhopodentales Peristome teeth not split. Mostly epixylic. Single family Calymperaceae (Syrrhopdon Plate X, Calymperes Plate XI).

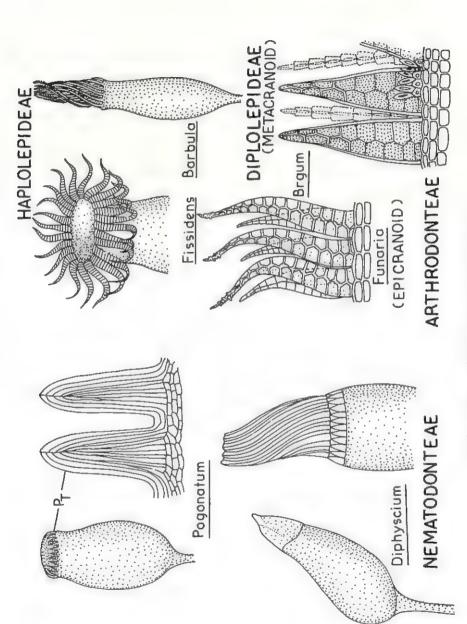


Fig 3. Some paristome forms of Bryidae.

- Order 7. Pottiales Peristome teeth usually split into filaments but sometimes irregular. Single family Pottiaceae. Important genera: Anoectangium Plate XI, Reimersia & Hyophila Plate XII, Barbula & Hydrogonium Plate XIII, Semibarbula & Bryoerythrophyllum Plate XIV. Merceva & Syntrichia Plate XV, Leptodontium Plate XVI).
- Order 8. **Grimmiales**—Peristome teeth irregularly split. At least some leaf cells show sinuose walls. Leaves often with transparent (hoary) tips. Single family Grimmiaceae. Important genera: Coscinodon (Plate XVII), Grimmia (Plate XVIII) and Racomitrium (mostly pleurocarpous—Plate XVIII).
- Series II. HETEROLEPIDEAE—Peristome variable—teeth in 1 ring or 2 rings or absent. Acrocarpic Order 9. **Encalyptales**—Single family Encalyptaceae with single genus *Encalypta*. In India distribution limited only to the North-West.
- Series III. DIPLOLEPIDEAE-Peristome teeth normally in 2 rings.
- Subseries 1. EPICRANOIDEAE Exostome and endostome teeth juxtaposed on one another. Acrocarpous.
- Order 10. Funariales Peristome teeth may become 1-ringed or absent by reduction. Families Ephemeraceae, Funariaceae (Genera: *Physcomitrium*—Plate XVIII, *Entosthodon*—Plate XVIII and *Funaria*—Plate XIX) and Splachnaceae (*Gymnostomiella*—Plate XIX, *Tetraplodon*—Plate XX).
- Subseries 2. METACRANOIDEAE Exostome and endostome teeth alternate. Acrocarpous families followed by pleurocarpous families.
- Order 11. **Eubryales** Acrocarpous families followed by pleurocarpous ones. Only acrocarpous families are represented in India. Important families: Bryaceae (Important genera: *Pohlia*—Plate XX, *Brachymenium*—Plate XXI, *Anomobryum*, *Bryum*—Plate XXI, *Rhodobryum*—Plate XXII), Mniaceae (*Mnium*—Plate XXIII), Bartramiaceae (*Bartramia* & *Fleischerobryum*—Plate XXIII), *Bartramidula*—Plate XXIV), Timmiaceae (*Timmia*—Plate XXIV).
- Order 12. Isobryales Mostly pleurocarpous families but a few at the beginning are acrocarpous. The endostome ring of peristome usually not developed. Important families: Orthotrichaceae (Zygodon & Macromitrium—Plate XXVI), Climaciaceae (Climacium—Plate XXVI) Trachypodaceae (Trachypodopsis—Plate XXVII), Myuriaceae, Pterobryaceae (Trachyloma & Penzigiella—Plate XXVII, Pterobryopsis—Plate XXVIII), Meteoriaceae (Meteorium—Plate XXVIII, Barbella—Plate XXIX), Neckeraceae (Neckera—Plate XXIX, Thamnobryum—Plate XXX).
- Order 13. Hookeriales Soft, pleurocarpous mosses in tropical to temperate rain forests. Important families: Hookeriaceae (Daltonia Plate XXX, Distichophyllum & Hookeria Plate XXXI, Hypopterygiaceae (Cyathophorella & Dendrocyathophorum Plate XXXII, Hypopterygium Plate XXXIII).
- Order 14. Hypnobryales A vast group of pleurocarpous mosses probably still evolving in the tropical rain forests. Important families: Leskeaceae (*Regmatodon**—Plate XXXIII, *Lescuraea**—Plate XXXIV), Thuidiaceae (*Claopodium**—Plate XXXIV, *Abietinella & Thuidium**—Plate XXXVI, *Actinothuidium**—Plate XXXVII, *Amblystegiaceae (*Drepanocladus**—Plate XXXVII), *Calliergonella**—Plate XXXVIII), *Brachytheciaceae (*Deurozium**—Plate XXXVIII), *Entodontaceae (*Pleurozium** & Trachyphyllum**—Plate XXXIX, *Entodon & Erythrodontium**—Plate XLI, *Plagiotheciaceae (*Plagiothecium** & Stereophyllum**—Plate XLI), *Sematophyllaceae (*Wijkia** & Meiothecium**—Plate XLII, *Sematophyllum** & Foreauella**—Plate XLIII, *Brotherella** & Trichosteleum**—Plate XLIV, *Taxithelium**—Plate XLV), *Hypnaceae (*Taxiphyllum**—Plate XLV, *Isopterygium** & Hypnum**—Plate XLVI, *Ectropothecium** & Vesicularia**—Plate XLVII, *Ptilium**—Plate XLVIII), *Rhytidiaceae (*Rhytidium**—Plate XLVIII), *Rhytidiadelphus**—Plate XLIX), *Hylocomiaceae (*Hylocomium**—Plate XLIX), *Macrothamnium** & Leptohymenium**—Plate L).

COLLECTION AND PRESERVATION OF MOSSES

When collecting, only clean specimens should be selected. "Weed" specimens i.e., where many species are mixed together, are not desirable. After collection, the material should be carefully cleaned. This cleaning should not be harsh, otherwise fragile parts like calyptra, operculum or gemmae get lost. Novices have the idea that these specimens should now be preserved in bottles of preservatives (formalin, alcohol etc.) as is done in the case of soft Thallophytes or they are to be kept pressed in herbarium presses as is done in case of the higher plants. Mosses after collection from their habitats are often wet. The tufts should be kept spread between sheets of blotting paper but no heavy pressure is to be applied to it. The blotting papers should be changed at quick intervals so that the mosses become dry. If the mosses are dried in this manner, the natural colour and lustre remains unchanged. When properly dried, it is possible to fix them on herbarium sheets with glue etc. as is done for higher plants. But, it is more convenient to put them in small cellophane or transparent paper envelopes and then keep each envelope in a thick paper packet folded as shown in Fig. 4. It is quite easy to store a large number of packets in suitable drawers in a cabinet. Each packet should have pasted on it the usual Herbarium label showing the name of the Herbarium, the number of the specimen in the Herbarium Record, the name of the plant, family, place from where collected with detailed ecological notes (edaphic, climatic, altitude, light and water conditions, height on the host if epiphyte, etc.), at the end the names of the Identifier and the Collector with the date of collection.

Specimens collected in this way remain good for a long time and when this dry material is soaked in water for some time it may easily be used for dissection and class work. Pieces of this material retains its colour and even its capacity for regeneration for a few years.

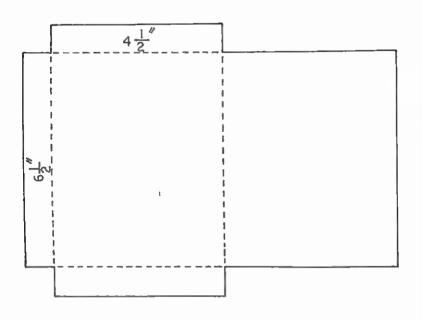
When a large number of specimens are to be collected during a field excursion, field notebooks are to be used. These are specially made with detachable numbered tags on each page. Each sample is put inside a paper or plastic envelope, all the data entered in the field book and one numbered tag from that page is torn off and placed inside that packet. A large number of such sample packets are then pushed inside a sidebag or a kitbag. As soon as the collector returns to his camp, the samples are put between blotting papers never forgetting to keep the numbered tags in place. If the samples are kept inside a wet packet for too long a time, the colour and even the material is likely to get spoilt.

Permanent slides

Many mosses are very small and a whole fruiting plant may be mounted on a slide under a coverslip. For large specimens, dissections may be similarly mounted. For quick examination this may be mounted in plain water and the coverslip sealed with paraffin. Such preparations may well last for a month. For longer lasting preparations glycerine should be used. The specimen may be left in 50% aqueous glycerine overnight and then mounted and sealed the next day.

The best permanent slide, however, is mounted in gum chloral. The gum chloral mounting medium is prepared in this way (Berlese's fluid: Dissolve 40 gm of gum arabic in 100 ml of distilled water for 48 hours. Add 20 ml pure glycerine and 50 gm chloral hydrate. Heat gently in a waterbath until the chloral hydrate is dissolved. Then filter hot through filter paper. Cool.) Put a large drop of this solution on the slide (so that it would even spread out of the coverslip forming a ring) and transfer the material direct from water to this gum chloral, cover with coverslip. The extra solution round the coverslip would contract with drying and also seal the preparation

Collection of mosses is a fun even for amateurs. There are amateur moss collectors in most advanced countries. In Japan mosses form a part of gardening. The Saihoji temple in Kioto is called 'Moss Temple' because the garden lay out shows a splendid collection of mosses. There is a large number of mosses (almost 2000) and their splendour can be appreciated in the moist forests in the Himalayas, the Himalayan foothills, the Nilgiris, the Ghats etc. The author would be grateful if this small book inspires even a few people in India, although only 100 could be included here.



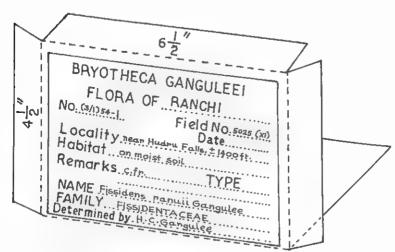


Fig 4.

PREPARING MUSEUM SPECIMENS

Mosses can be displayed in the museum show cases in beautiful green colour if they are prepared as follows:

Fresh specimens should be wiped of all water and then kept in a glass trough (of the proper size) filled with a solution of

Sodium sulphite - 16 grams

H_sSO, (concentrated) - 20 cc.

-1000 cc. Distilled water

The trough should be covered by a glass sheet. After overnight soaking, the specimen should be taken out and carefully washed in distilled water and the water drained off. Next, this treated specimen (which looks bleached) is again kept in a trough of saturated copper sulphate solution in distilled water and kept covered. After 24 hours (sometimes it may take more time) the green colour will be found to have reappeared. This material is now tied with thin but strong thread on a glass plate or slide (according to size). Care should be taken as the material becomes rather soft because of some maceration. After the specimen is arranged it should be kept inside a museum iar (vertical or a little slanting) filled with a weak solution of formalin. The lar should be sealed with paraffin wax. Any future loss of the liquid should be made good by pouring distilled water and resealing.

It has been found that the material retains its bright green colour for several years if prepared in this way.

IDENTIFICATION KEY FOR THE ONE HUNDRED GENERA ILLUSTRATED

1.	Leaves one layer thick, without costa, with large, dead, colourless, spirally thickened,	
	fibrous cells and narrow, green chlorophyllose cells. Plants, lax, greenish white (may be tinted). Semi-aquatic Leaves of different arsolation	1. Sphagnum 2
2.	Plants erect. Acrocapous Plants creeping or hanging. Pleurocarpous	3 48
3.	Plants terrestrial or rupestrine Plants epiphytic or corticolous	4 45
4.	Small plants growing on granite rock in alpine climate. Capsule without peristome. Pseudopodium present. Plants without any pseudopodium	2. Andreaea 5
5.	Peristome teeth solid (Nematodonteae) Peristome teeth scaly (Arthrodonteae)	6 10
6.	Peristome teeth united to form a twisted cylinder Peristome teeth separate or absent Leaf median part thick, with longitudinal lamini on surface	3. Diphyscium
7.	Peristome teeth absent. Capsule flat, hood-like. Calyptra cucullate Peristome teeth present	7. Lyellia 8
8.	Lamelli low, confined to a narrow median region (vein). Calyptra cucullate Lamelli high, covering most of leaf breadth	4. Atrichum 9
9	Capsule cylindrical Calyptra fibrose, cap-like. Peristome teeth 32	5. Pogonatum
10	Capsule angular in t.s. Calyptra as in <i>Pogonatum</i> . Peristome teeth ±64	6. Polytrichum
•0	Small delicate plants on soil. Gametophyte as in Dicranales but peristome, operculum absent, cleistocarpic primitive type Capsule ± normal	8 Archidium 11

	11.	Capsule with short seta, hidden within leaves. On sandy soil	9. G	arckea 12
		Capsule with normal long seta		12
	12.	Capsule with narrow, abnormally long apophysis. Growing on	10	Trematodon
		wet soil	10.	13
		Capsule without apophysis or with normal apophysis		14
	13.	Peristome teeth absent by degeneration		20
		Peristome teeth normal		15
	14.			16
		Plants growing on rocks and bricks		10
	15.	Small Funaria-like plants growing on road-side or flowering		
		pots. Seta short or long. Operculum beaked, often highly	25	Physcomitrium
		coloured. Calyptra not cucullate	30.	Filyscommon
		Small Funaria-like plants growing on soil. Operculum convex.	00	Franchadon
		Calyptra cucullate	36.	Entosthodon
	16.	Small gregarious plants growing on rocks or walls		17
		Larger plants on rocks and bricks		18
	17.	Densely gregarious plants on open hills with acute-pointed		4
		leaves having complete nerves	22.	Anoectangium
		Small gregarious plants on bricks and walls (calcicole) with		
		sterile and fertile plants. Leaf point obtuse or rounded.	00	O
		Nerves incomplete	38.	Gymnostmiella
	18.	Long slender plants growing on rocks or even inside wet	00	market and a
		mosses on trees. Leaf tip narrowly acute	23.	Reimersia
		Comparatively robust plants with wider leaf tips		19
	19.	Calcicole plants on bricks and rocks with starry tops. Leaves		
		with broad, obtuse tips, colourless at base. Capsule long,		4.4
		cylindrical	24.	Hyophila
ŀ		'Copper moss' growing on rocky soil containing copper or		
		iron. Yellow-green, large and broad leaves with ovate top and		
		pale base	29.	Merceya
	20.	Plants erect, typically distichous. Leaves with characteristic		
		sheathing lamini	19.	Fissidens
		Plants with leaves in three or more rows		21
	21.	Peristome teeth in one ring (Haplolepideae)		22
		Peristome teeth in two rings (Diplolepideae)		35
	22.	Penstome shred into filaments		23
		Peristome teeth broader, usually dicranate		26
	23.	Peristome teeth spirally twisted more than one turn		24
		Peristome teeth not twisted spiral		25
	24	Coarse plants with leaf base cells not very lax. Growing on		
		hills	25	. Barbula
		Softer plants with laxer leaf base cells. Growing on alluvial or		
		hill soil	26	. Hydrogonium
	25	Peristome teeth short and not completing any spiral	27	. Semibarbula
		Peristome teeth lor g, distant and erect	28	B. Bryoerytrophyllum
	26	- "		27
	20	Peristome teeth not dicranate or filamentous		33
	27			28
	21			29
		Peristome teeth not fully split		LJ
	28		4.1	. Wilsoniella
		apophysis. Leaf cells smooth	1	. VVHOUTHERE
		Large plants without the narrow apophysis. Leaf cells	-	1. Leptodontium
		papillose	3	I. Espiodomia

30 29. Seta erect 32 Seta cygneous 16. Dicranum 30. Alar distinct 31 Alar not differentiated 31. Leaf narrowing from a broad, erect, sheathing base; 15. Symblepharis characteristically curled when dry 12. Dicranella Leaf base only very shortly sheathing, not so curled when dry 32. Slender, minute plants. Costa narrow. Seta cygneous. Usually 13. Camylopodium mixed with larger mosses like Pogonatum Larger, caespitose plants with broader costa. Seta cygneous 14. Campylopus 33. Leaves green with pale bases and with long, narrow extensions of vein forming spinous apiculi. Peristome tubular below and shred into spirally twisted filaments at tip 30. Syntrichia Leaf tips 'hoary' (transparent, narrow linear). Penstome teeth lanceolate, irregularly split 32. Coscinodun 34. Calyptra plicate, campanulate 33. Grimmia Calyptra not plicate, cap-like 35. Exostome teeth overlapping endostome teeth (Epicranoid) 36 Exostome teeth alternating with endostome teeth 3/ (Metacranoid) 36. Capsule with narrow apophysis. Peristome teeth spirally arranged. Both exostome and endostome present 37. Funaria Capsule with swollen apophysis. Peristome teeth hanging downwards when dry. One ring suppressed 39. Tetraplodon 38 37. Capsule not furrowed Capsule usually furrowed or striped when dry 43 41. Brachymenium 38. Capsule erect 38 Capsule nodding 40 39. Leaves normal 44 Leaves very large 40. Plants resembling Polytrichaceae. Rib (costa) and lamina cells mamillose on top. Endostome with high basal membrane and 48. Timmia 64 ciliate teeth on top 41 Plants like ordinary mosses 41. Plants very large, with a whorl of branches on top 46. Fleischerobryum Plants not so large 42. Upper leaf cells narrower and longer 40. Pohlia 42. Bryum Upper leaf cells broader, usually rhomboid Peristome mostly with both rings. Leaves narrower in upper 43. 45. Bartramia two-thirds Peristome mostly with one ring aborted. Leaf lanceolate 47. Bartramidula 43. Rhodobryum 44. Leaves not bordered 44. Mnium Leaves usually bordered 45. Plants whitish as in the leaf a single layer of green chlorocyst cells is sandwiched between several layers of colourless cells 48 47 Plants normal green except at the hyaline base 46. Leaves canaliculate above. Chlorocyst cells four-sided. 17. Leucobryum Capsule inclined Leaves flat above. Chlorocyst cells three-sided. Capsule erect 18. Octoblepharum A narrow, spinose leaf border differentiated which is often 20 Syrrhopodon hyaline. Peristome present

Border not differentiated. Characteristically gemmiferous.

21. Calymperes

Peristome undeveloped if capsule is present

48.	Leaves with long tips and leaf cells strongly sinuose (Grimmiaceae characters)	34.	Racomitrium
	Leaves not with above Grimmiaceae characters		49
49.	The third row of leaves amphigastrial		50
45.	All rows of leaves similar		52
50	Plants not dendroid	63	Cyathophorella
50.	Plants dendroid	00.	51
E.1	Leaves completely bordered	65	Hypopterygium
51.	Only a trace of leaf border at base		Dendrocya-
	Only a trace of lear border at case	01.	thophorum
52	Leaves completely ecostate		53
UZ.	At least the stem leaves with some sort of vein		63
50			64
53.			
	Capsule inclined	70	56 Entodon
54.	Capsule narrow, long	,	
	Capsule shorter, comparatively broader		Erythrodontium
55.	0	84.	Meiothecium
	Peristome normal double		56
56.			57
	Plants denser and not so complanate	00	58
57.	Leaves in several rows	62.	Hookeria
	Leaves in two rows (except at tips). Almost glued on the		** * * * **
	rocks		. Taxiphyllum
58.	Alar not differentiated	91.	Isopterygium
	Alar differentiated		59
59.	Stem leaf and branch leaf differ greatly, at least in size	83.	. Wijkia
	Stem leaf and branch leaf do not differ much		60
60.	Leaf cells not papillose		61
	Leaf cells with papilli on lumen		62
61.	Leaf tip erect	85.	. Sematophyllum
	Leaf tip narrower, falcate	87.	. Brotherella
62.	Operculum long rostrate	88.	. Trichosteleum
	Operculum short conical. Mostly corticolous	89.	. Taxithelium
63.	Leaves definitely with short single veins		64
	Leaves with short double veins which is sometimes variable		
	into short single veins		88
64.	_		65
0 11	Plants rather large, sometimes dendroid		70
65.	Calyptra mitriform, fimbriate at base		66
00.	Calyptra cucullate, not fimbriate at base		67
66.		00	
00.	the state of the s	00	. Daltonia
67	Leaves laxer, broader and shorter, often complanate	10	. Distichophyllum
07.	Top leaf cells rounded, thick-walled	49	. Zygodon
60	Top leaf cells not rounded		68
68.	Top leaf cells linear, quadrate to subquadrate alar	82	. Stereophyllum
	Top leaf cells rhomboidal, quadrate to subquadrate at alar		69
69.	- describe most shorter than endostonie	66	. Regmatodon
	Exostome endostome almost of same height	67	. Lescuraea
70.	Plants erect (sometimes trailing), frondose or dendroid		71
	Plants creeping or pendulous		75
71.	Plants very characteristically dendroid		72
	Plants of different habit		73

72. Dendroid plants arising at intervals from a creeping, runnerlike, underground, rhizomatous shoot 51 Climacium Underground rhizomatous stem rather tuberose with only irregular creeping branches 59. Thamnobryum 73. Capsule globose, leaf ovate-round 54. Penzigiella Capsule and leaf narrower and longer 74 74. 53. Trachyloma Capsule narrow cylindrical, erect Capsule curved cylindrical, inclined 96. Rhytidium Creeping and then pendulous epiphytes 78 Creeping plants RΠ 76 Leaves oblong-ovate, suddenly subulate-acuminate 56 Meteorium Leaves lanceolate 77 77. Leaves ovate-lanceolate 55. Pterobryopsis Leaves narrower lanceolate 78 Leaves concave, leaf cells smooth 58. Neckera Leaf cells papillose (rarely smooth) 79 Leaf base narrower. Endostome with a low basal membrane. equal to exostome in height 52. Trachypodopsis Leaf base wider. Endostome without basal membrane, usually reduced, shorter than exostome 57 Rarhella 80. Leaf tips narrow uncinate (hooked) to strongly falcate 72. Drepanocladus Leaf tips neither so narrow nor so curved 81 Very large, pinnate frondose plants growing in dripping water 81 usually mixed with Sphagnum 71. Actinothuidium Plants in a different habitat 82 82. Calyptra generally campanulate, densely pilose, covering the whole capsule 50. Macromitrium Calvotra smooth 83 83. Capsule curved, horizontal 84 Capsule erect or nodding 85 Operculum conical, with a short beak 75. Brachythecium 84. Operculum with a long beak 76. Eurhynchium 85. Leaf cells not papillose 74. Homalothecium 88 Leaf cells papillose 86. Paraphyllia not common 68. Claopodium 87 Paraphyllia prominent Stem leaves very large. Robust plants 69. Abietinella 87. Creeping and branching plants forming dense mats all over 70. Thuidium the Himalavas 89 Leaf cells smooth 88. At least some leaf cells papillose 96 89. Comparatively smaller plants 81. Plagiothecium 90 Larger plants 91 90. Large, tufted, creeping plants 94 Large tufted plants with many erect shoots Branches curled at tips with characteristically secund-falcate 91. 86. Foreauella leaves when dry 92 Above character not found 92. 92. Hypnum Leaves falcate to circinate when dry 93 Leaves not falcate when dry 93. Marginal leafcell-tips sometimes extended to cause papillosity 93. Ectropothecium 94. Vesicularia

All cells smooth

- 94. Leaves falcate to circinate when dry Leaves not falcate when dry
- Plants very robust with stiff, red stems
 Large plants with ascending main stems but not so stiff
- Plants creeping with the branches having a tendency to erectness
 Main stem trailing or not but shoots erect
- Long trailing plants with erect shoots here and there Plants not long trailing
- 98 Beautiful frondose plants with proliferating shoots and cordate-acute leaves

 Erect shoots only prominent
- Very stiff erect shoots
 Erect shoots prominent but not so stiff

- 95. Ptilium
 - 95
- 77. Pleurozium
- 73. Calliergonella
- 78. Trachyphyllum 97
- 99. Macrothamnium
- 98. Hylocomium

99

97. Rhytidiadelphus 100. Leptohymenium

ABBREVIATIONS USED IN THE ILLUSTRATIONS

Anth - Antheridium

Arch - Archegonium

C — Capsule C_D — Dry capsule

Cm — Capsule mouth
Cal — Calyptra
G — Gemmae

L —Leaf

L_{AC} — Leaf apex
L_{AC} — Léaf apex cells
L_{AM} — Amphigastrial leaf

L_B — Branch leaf
L_{BC} — Leaf base cells

· L_{Bt.s.} — Leaf base transverse section

L_C — Leaf cells

L_G — Germmiferous leaf

L_{MC} — Leaf margin cells

L_P — Perichaetial leaf

L_{PA} — Perichaetial leaf apex

Ls — Stem leaf
Ls — Leaf surface
Lsc — Leaf shoulder cells

Lt.s. — Transverse section of leaf

O_P — Operculum

P — Plant or plant part

P_A — Plant apex

P_D — Dry plant or plant part

P_T — Peristome, Peristome part or Peristome teeth
Par — Paraphysis

Para — Paraphyllia S_P — Sporophyte

S_p — Spores Vag — Vaginula

Descriptions & Illustrations of One Hundred Indian Genera

SPHAGNIDAE: SPHAGNALES: SPHAGNACEAE: SPHAGNUM

Sphagnum palustre Linn.

Robust, greenish white to brown (when old), long, branching, lax plants forming tufts growing in very moist situations, usually in dripping water. Leaves without veins, with cells one layer thick and with characteristic areolation: large, rhomboidal, fibrose, porose, transparent cells bordered on all sides by narrow elongated, chlorophyllose cells which are narrow-triangular in cross-section. Stem epidermis formed by about 3 layers of fibrose cells. 4 or 5 layers of smaller, thick-walled, brown cells take up the cortical position. The central cylinder is formed of larger, thin-walled, yellow-brown cells. Stem leaves 1 to 2 mm. long, tongue-shaped with top cells eroded showing lashes. Branch leaves larger, up to 3 mm. long, elongate-oval, cymbiform. Perichaetial leaves large (up to 6 mm. long). 2 to 3 shorophytes on pseudopodia on the top of each shoot is normal.

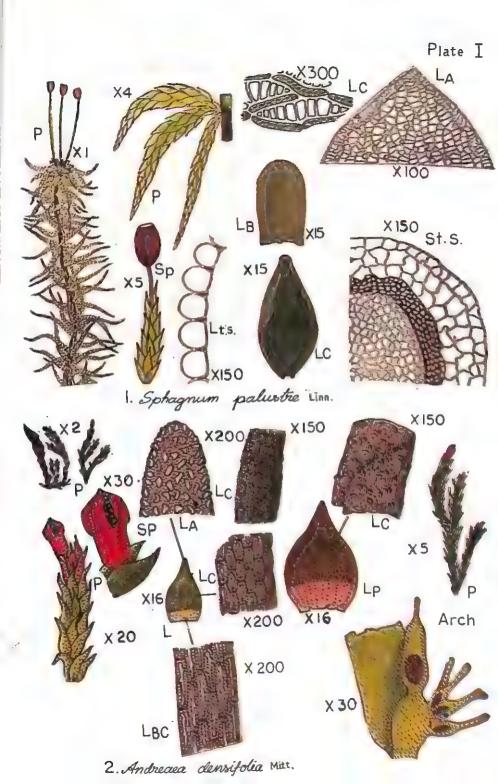
Distribution: Sikkim, Darjeeling, Khasia, East Nepal, Bhutan at above 2000 m. Found all over the temperate sub-arctic regions of Asia, Europe, North & Central America as well as some Pacific Islands. A cosmopolitan species.

ANDREAEIDAE: ANDREAEALES: ANDREAEACEAE: ANDREAEA

2. Andreaea densifolia Mitt.

Plants slender, in small scattered tufts on siliceous granitic rocks, dark to lighter brown, very brittle when old, up to 1.5 cm. high, simple to forked dichotomously, erect, growing in alpine climate. Leaves densely crowded, small (0.6 to 0.8 mm. long), somewhat spreading in upper half, appressed to stem with raised tips when dry; concave, oval, narrowing down at top but tip blunt, margin slightly incurved when dry but entire, papillose on vein, without costa. Leaf base yellow, transparent; leaf cells nighly incrassate, gradually becoming shorter towards tip, elongate hexagonal below, quadrate to rounded-hexagonal at top. Perichaetial leaves longer and broader (\pm 1.5 × 1 mm.), reddish in colour. Several archegonia at tip but usually one sporophyte develops. Sporophyte on very short pseudopodium (\pm 0.7 mm.) raising the capsule just above the perichatial leaves. Small capsule splitting into 4 or 5 valves to half or more of length.

Distribution: Endemic in Sikkim (Lachen, 2750 m.). Four endemic species were collected from North Sikkim by J.D. Hooker in 1848. Since then they have never been collected again.



BRYIDAE: NEMATODONTEAE BUXBAUMIALES: DIPHYSCIACEAE: DIPHYSCIUM

3 Diphyscium longifolium Griff.

Tufted brownish green plants up to 2.5 cm. high with erectopatent leaves which are rosette-like at top. Leaves crispate, involute in the margins and rolled when dry; spathulate from a rectangular, narrower, sheathing base, up to 7.7 mm. long and 1.1 mm. broad at top and 0.8 mm. broad at base. Leaf border thicker, serrulate in the upper broader part; apex subobtuse. Vein brown, prominent, complete, gradually narrowed above, reaching tip. T s. of leaf shows cells two-layer thick, thicker at costa and margin. Leaf base lighter with elongated, rectangular cells with smooth and thinner walls. Upper lamina cells thick-walled, papillose, short rectangular to quadrate-hexagonal. Perichaetial leaves many, erect, up to 2.9 mm. long with the vein exserted into a long arista, \pm 4.9 mm. long, tips of upper ones truncate. In the sporophyte on the top of the plant, the seta is almost absent with the capsule mostly covered by the perichaetial leaves. Capsule lightly tinted, bent on one side, asymmetrical, urn mouth narrow. Exostome not developed. Endostome whitish brown, fused to form a somewhat twisted cylinder showing 16 plicae. Spores small, rounded, irregular in size. Operculum short conic-rostrate, attached to the top of the columella. Calyptra subulate at top with a longitudinal fissure on one side.

Distribution: Khasia Hills (Moosmai, Myrung & Kalapanee), Ceylon, Tonkin. They have not been collected from India since Griffith & J.D. Hooker in the 1840s. A South-East Asiatic species

POLYTRICHALES: POLYTRICHACEAE: ATRICHUM

4. Atrichum undulatum (Hedw.) Beauv.

Plants medium-sized to large, soft, yellowish-green. Stems mostly simple, up to 3.5 cm. high. Leaves curled when dry. Lower leaves small. Upper leaves erectopatent to erect-spreading, carinate, undulating (wavy), narrow lingulate from a non-sheathing base, up to 9.5 mm. long. Lamina rough on back with teeth in oblique rows on both sides of the vein. Margin swollen (multilayered), cartilaginous with sharp double teeth from tip to a little above leaf base. Costa comparatively narrow, toothed on back, ending in spines just below leaf tip. Longitudinal lamini low (1 to 4 cells high), few (2 to 5), restricted only to the ventral face of the narrow costa. Leaf cells thick-walled, elongated rectangular at base, rounded-hexagonal at top; marginal cartilaginous cells very narrow and long. Seta single, up to 3.4 cm. long. Capsule slightly bent, long, cylindrical, up to 8 mm. long. Peristome teeth 32, solid with brown striolations. Spores rounded, 11 to 16 µ in diameter. Operculum conical long rostrate. Calyptra narrow, cucullate, scabrous above, smooth below.

Distribution: Darjeeling, Sikkim, Khasia, East Nepal to Western Himalaya. Common all over the Northern Hemisphere (Asia, Europe, North America).

Plate II



BRYIDAE: NEMATODONTEAE: POLYTRICHALES. POLYTRICHACEAE: POGONATUM

5. Pogonatum microstomum (Schwaegr.) Brid

Dioicous. Robust, coppery green plants in lax tufts. Stem simple or innovating, 5 cm. or more long, with pale tomenta at the basal rhizomatous region. Lower leaves small, scaly. Upper leaves rigid, erect-spreading, appressed to stem and somewhat incurved when dry, lanceolate from a wider, yellowish, somewhat sheathing base; up to 9.5 mm. long; apex sharply acute; margin sharply toothed almost to the base of the lamina. Costa reddish brown, strongly toothed on back, narrow at the leaf base but very wide in the lamina. Longitudinal lamini numerous, covering most of the ventral face, some 5 cells high, the topmost cells large, divided to base into two flask-shaped cells. Leaf base cells long, narrow rectangular, becoming shorter, wider and thick-walled in lamina, finally rounded-quadrate at tip. Seta up to 3 cm. long, usually 1 but sometimes 2 or 3 from each perichaetium. Capsule erect or inclined, reddish brown, ± 6 mm. long, rounded in t.s., ovate-cylindrical; exothecial cells thick-walled; columella solid, 4 to 5 rayed. Peristome teeth 32, solid with brown striation. Spores rounded, 9 to 14.5 μ in diameter. Operculum convex, shortly rostrate. Felty, white calyptra covers whole capsule.

Distribution: Very common all over the Himalayas and the connected ranges, the Ghats, Nilgiri, Palni, Ceylon, South China, Indonesia, Taiwan, Philippines. A South-East Asiatic species.

POLYTRICHALES: POLYTRICHACEAE: POLYTRICHUM

6. Polytrichum juniperinum Hedw.

Polytrichum generally resembles Pogonatum and the British Bryologists of the old school include Pogonatum within Polytrichum. But, there are important differences in the capsule: In Polytrichum the capsule is angular in cross-section and the teeth are 64 and smaller. In Polytrichum juniperinum the tip cells of the lamelli are not split and are flask-shaped to long oval.

Distribution: Bhutan, Western Himalaya, Kashmir and all the alpine mountains of Asia, Europe, Africa, North & South America, Australia. A cosmopolitan species.



X200

6. Polytrichum juniperinum. Hedw.

BRYIDAE: NEMATODONTEAE: POLYTRICHALES: POLYTRICHACEAE: LYELLIA

7. Lyellia crispa R. Br.

Dioicous. Robust, yellow-green plants in tufts. Stem erect, rigid, with basal rhizoids; simple to sparsely branched in females: lower part devoid of leaves, often innovating from tip, up to 15 cm. long. Lower leaves small, upper large, stiff, lanceolate-subulate; sheathing, paler and broader at base, suddenly narrowing at top into the lamina, \pm 1.3 cm. long, margin of lamina sharply dentate to a little above base; 1 layer thick at margins and at base, 2-3 layered at median costal portion. Costa extending to leaf tip. Horizontal lamelli numerous, covering most of leaf, up to 8 cells high, cells thin-walled, top cells not differentiated. Basal leaf-cells narrow, elongated rectangular, thin-walled, suddenly changing at base shoulder to rounded-quadrate-thickwalled cells which character is retained in the lamina. Male flower buds apical, cup-like with many involucral bracts and paraphyses mixed with antheridia. Seta rigid, yellowish, up to 7.3 cm. long, usually one sometimes two in each perichaetium. Capsule whitish when young, dark brown when mature, ovoid to elliptical, rather thin (elliptic or lenticular in cross-section) bent like a snake-hood, narrow mouthed, \pm 9 mm. long. Peristome teeth not developed. Operculum small, conical, beaked. Calyptra cucullate, smooth, covering only the tip of the capsule. Spores small, round 7 to 8.5 μ in diameter.

Distribution: East Nepal, Darjeeling, Sikkim, Bhutan, Arunachal, Yunnan (China) and North America. It is an endangered species, disappearing from populated areas. The photo on the cover of this book was taken by the author at Darjeeling-Lebong roadside in 1963. But it is no longer

found there.

HAPLOLEPIDEAE: ARCHIDIALES: ARCHIDIACEAE: ARCHIDIUM

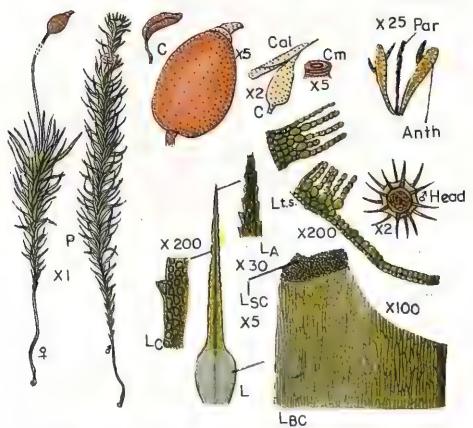
8. Archidium birmannicum Mitt. ex Dix.

Although there is no trace of peristome, the taxon is included within the Haplolepideae as the gametophyte is the same as found in the next order Dicranales.

Densely caespitose, olive-green to yellow-green, slender plants up to 4.3 mm. high (sterile plants may be a little larger) growing on the edges of rice pans shaded by bamboo groves. Fertile plants often showing persistent protonema at base. Stems branching with bud-like fertile shoots both at tips and sides. Leaves erect on sterile plants, patent on fertile shoots, narrow lanceolate, acuminate, \pm 1 mm. long, margin entire. Costa percurrent. Leaf cells narrow elongated rectangular to rhomboid, thin-walled, shorter at tip. Perichaetial leaves larger (\pm 1.4 mm long), spirally encircling the sporophyte. Sporophyte abundant. Capsule dark brown when mature, spherical, \pm 0.36 mm. in diameter, encircled by a jacket only one layer thick and containing only 8 large spores (largest at centre \pm 180 μ in diameter) inside without any columella; sessile without any seta, with only a short haustorial foot (\pm 0.12 mm. long) immersed in the gametophyte.

The gametophyte is just as in Dicranales (where it was included before) but the sporophyte is unlike any other moss, rather like a simple hepatic. This type of sporophyte is not likely to result from reduction.

Distribution: Upper Assam, Gangetic plain near Calcutta, Nilgiri and Palni Hills in South India, Moulmein in Burma. An Indo-Burmese species



7. Lyellia crispa R. Br.



BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: DICRANALES: DITRICHACEAE: GARCKEA

9. Garckea phascoides (Hook.) C. Muell.

Dioicous. Plants yellow-green in dense patches on sandy soil. Stem erect, usually simple, sometimes branched, up to 2.2 cm. high. Leaves crowded in comal tufts, sparse below; narrow lanceolate, erectopatent at top, more appressed to stem below, slenderly acuminate, up to 2 mm. long, recurved at tips when dry, margin entire. Leaf cells prosenchymatous, smooth, not much thick-walled. Costa prominent, short excurrent. Perichaetial leaves not much differentiated but \pm sheathing. One or more terminal sporangia hidden within leaves with very short seta and showing a small ovoid vaginula. Capsule short cylindirical, brown, \pm 1 mm. long. Operculum conicrostrate, \pm 0.5 mm. long, scabrous at tip. Calyptra small campanulate, scabrous. Peristome teeth 16, \pm 140 μ high, red-brown, coarsely papillose, inserted below rim, irregularly cleft into two or more segments. Spores spherical, brown, papillose, 20-26 μ in diameter. Ripe capsules in October-November.

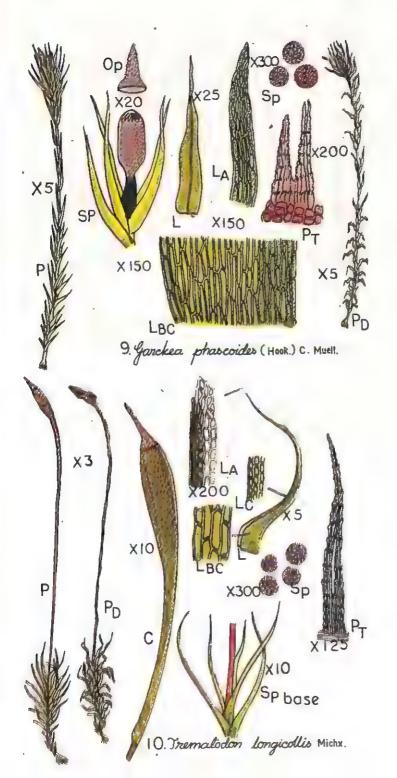
Distribution: East Nepal, Bhutan, Darjeeling, Khasia, Sylhet, Tripura, North Bengal Plains & Hills, Lateritic West Bengal (growing under shalforests), Andaman Is., N.W. India, S. India, Ceylon, Burma, Thailand, Indochina, Malaysia, Sumatra, Java, Philippines, New Guinea, Japan, Australia, Oceania, Madagascar, Central America (Panama). Cosmopolitan in the tropics.

HAPLOLEPIDEAE: DICRANALES: DICRANACEAE: TREMATODON

10. Trematodon longicollis Michx.

Autorcous. Small male shoots at the base of female shoots. Yellow-green, gregarious plants growing in patches on sandy soil and rocks getting enough moisture in shade. Stems 2 to 7 mm. high. Leaves erect-spreading, flexuose when dry, 2.5 to 4 mm. long, suddenly tapering from a broad, ovate-rectangular, concave, sheathing base (sheathing part about 1/8th of leaf length) to a long, narrow, canaliculate lamina, margin slightly toothed at apex, entire below. Costa yellow-brown, narrow at base, broader above but not filling the whole of the subula, ending just below apex. Leaf cells rectangular, lax and larger at base, becoming smaller rectangular above, smooth. Perichaetial leaves not much differentiated. Seta pale yellow, \pm erect very long (2 to 3 cm.). Capsule cylindrical, may be a little curved, urn ovate-cylindrical (2 to 3 mm. long) tapering into a long (2 to 3 times the urn), narrow cylindrical, spongy apophysis with a swelling (struma) at base. Peristome teeth red-brown, \pm 0.5 mm. high, split to slightly above base by one or two longitudinal perforations but united at tip, vertically striolate, nodose, papillose at tip. Spore round, yellow-brown, warty papillose, \pm 18 to 22.5 μ in diameter. Calyptra cucullate, entire at base, covering more than half the urn, \pm 4 mm. long in long capsules.

Distribution Darjeeling, Jalpaiguri, Assam, Arunachal, Manipur, Tripura, Chhotanagpur, Western Himalaya, South India (Nilgiri, Palni), Ceylon, Burma, Philippines, New Guinea, Taiwan, China, Japan, Korea, Siberia, Ryukiu, Hawaii, South Africa, Europe, Eastern United States, Cuba, Mexico to South America, New Zealand. A cosmopolitan species.



BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: DICRANALES: DICRANACEAE: WILSONIELLA

11. Wilsoniella decipiens (Mitt.) Alst.

Yellow-green plants forming loose mats on rock covered by thin soil. Stem branched, \pm 2.5 mm. high. Leaves erect-spreading, flaccid (curled and crumpled when dry), ligulate-lanceolate, \pm 3 mm. long, canaliculate, margins flat and smooth (may be slightly denticulate by projecting cell-tips at leaf tip). Costa slender, ending just below apex. Leaf cells smooth, rectangular (may be rhomboidal), up to 140 \times 23 μ at base, gradually shorter above. Seta slender, one at the tip of every branch, \pm erect, up to 1.3 cm. long. Capsule slightly nodding, with a brown, cylindrical um, \pm 1.72 mm. long including a narrower, paler but short apophysis (not more than 1½5th of the total length). Operculum conic long rostrate, \pm 1 mm. high, paler at tip. Peristome teeth \pm 360 μ high, filliform; each spirally thickened, papillose and cleft into two up to the base but the segments are not usually separated showing only a vertical line of cleavage. Calyptra cucullate extending halfway down the urn and enclosing only the tip of the capsule. Spores deep brown, minutely papillose, round, 19 to 21 μ in diameter. Fruiting in October in Orissa.

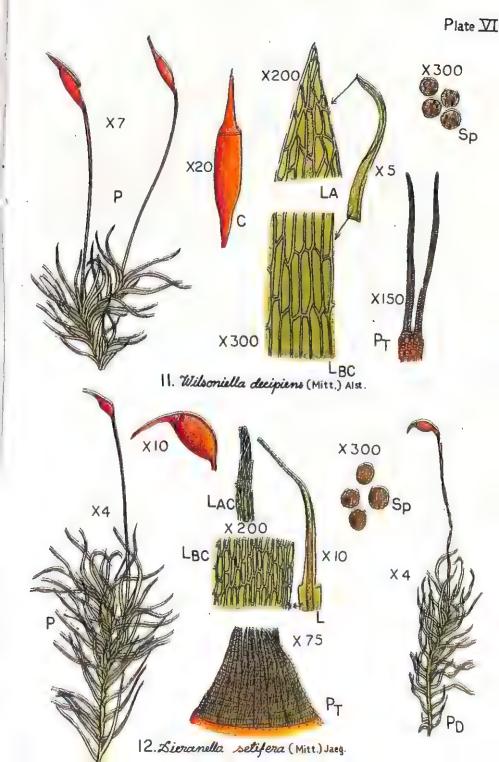
Distribution: Orissa (Puri District Hills), South India (Palni), Ceylon, Java, Borneo, New Guinea, Philippines. A South-East Asiatic species.

HAPLOLEPIDEAE: DICRANALES: DICRANACEAE: DICRANELLA

12. Dicranella setifera (Mitt.) Jaeg.

Relatively large, closely tufted plants. Stem erect, up to 2.3 cm. high, often branched below fruiting apex. Leaves widely spreading, rather lax, more crowded above, up to 7 mm. long, suddenly narrowing from a broad, rectangular sheathing base into a long, canaliculate subula which is formed only by the excurrent costa at the faintly toothed tip; leaf shrunk and more flexuose when dry. Costa brown, $\frac{1}{2}$ of leaf breadth at base, excurrent, more or less well defined. Basal leaf cells narrow rectangular (up to $\frac{56}{\mu}$ long), shorter near leaf insertion, narrower at tip. Seta single, erect, yellow, up to 1.8 cm. long. Capsule red-brown, inclined asymmetrical, definitely strumose and longitudinally furrowed when dry, $\frac{1}{2}$ 1.8 mm. long and 1 mm. in diameter. Peristome teeth brown, $\frac{16}{2}$, $\frac{1}{2}$, \frac

Distribution. Darjeeling, Sikkim, Bhutan, Assam, Borneo, Java, New Guinea, Philippines An Indomalesian species.



BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: DICRANALES: DICRANACEAE: CAMPYLOPODIUM

13. Campylopodium khasianum (Griff.) Par.

Dioicous. Small, tufted terrestrial plants often mixed with other mosses, specially *Pogonatum* spp. Stems erect, usually simple, up to 1.2 cm. long. Leaves lax below, more crowded at top of female plant, up to 5.5 mm. long, shorter at base of plant; abruptly narrowing down from a short (about ¼ of leaf length), erect, broad, sheathing base into a long, slender subula composed mainly of the excurrent costa. Leaf canaliculate. Leaf tip pointed, almost hyaline. Leaf erect-spreading, more flexuose when dry. Basal leaf cells rectangular, pellucid, up to 85 μ long. A patch of shorter, irregular cells at leaf shoulder; top cells narrow, elongated, smaller than at base. Costa brown, covering not more than a quarter of leaf base where it is not very definite. Seta single, brown, usually strongly cygneous whether moist or dry but sometimes almost erect when dry, stiff, \pm 5 mm. long. Capsule brown to red-brown, \pm 1.4 mm. long, ovate, rough on surface, longitudinally furrowed when dry, with a short apophysis. Peristome teeth red-brown, vertically striped and split into two up to below the middle, \pm 0.25 mm. long. Operculum conicrostrate, shorter than the capsule length. Calyptra pale, cucullate with smooth base. Spore brown, very warty, 22.5 to 28 μ in diameter. Fruiting in October.

Distribution: East Nepal, Darjeeling, Sikkim, Khasia Hills, South India, Ceylon. An Indo-Ceylonese species.

HAPLOLEPIDEAE: DICRANALES: DICRANACEAE: CAMPYLOPUS

14. Campylopus richardii Brid.

4, 0

Described variously under various names from different places. Dioicous, Densely caespitose, dark-green tufts of comose plants branching through proliferation from tips. Brown single stems (not counting proliferations) up to 2.5 cm. long, reddish tomentose below. Leaves crowded in comai tufts, up to 5 mm. long, erectopatent, not changing much when dry, lanceolate, canaliculate, extending into a narrow tip which is usually hyaline; margin usually inflexed above, not serrulate. Leaf base \pm 0.9 mm. wide, widest at alar region, often showing developing rhizoids from costa base. Alar cells inflated, irregular, red-brown, bulging to form auricles. Brown costa occupying about 1/3 of leaf breadth at base with stereides on both sides of the deuter row, wavy (said 10 be lamellose in some specimens) on back in cross-section. Basal lamella cells yellow-brown, irregularly rectangular, up to 30.5 imes 12 μ ; become more and more incrassate above, the lumen being reduced to rhomboidal oval slits at mid-lamina. Several sporophytes on comal tufts looking rike umbels. Seta red-brown, cygneous, ± 8 mm. long. Capsule red-brown, ovoid, ± 1.6 mm. long, sometimes rough at base, may or may not be furrowed when dry. Peristome teeth red-brown, \pm 430 μ high, dicranate to or below middle, often with unequal limbs, with slightly oblique vertical stripes below, papillose and paler above. Operculum conic-rostrate, ± 0.75 mm. high. Calyptra ± 1 mm. high, slit at one side, frilled at base. Spores light brown, pellucid, 11 2 to 12.6 μ in diameter. Fruiting from October to April.

Distribution: East Nepal, Darjeeling, Sikkim, Khasia, Parashnath, widespread over all the Himalayan and South Indian ranges or Ghats, Chhotanagpur, Ceylon, Burma, Vietnam, Malay, Lumatra, Java to Celebes, Borneo, New Guinea, Philippines, Taiwan, China, Japan, Hawaii, Tahiti, Sandwich Is., Central and South America. Widespread in Indo-Pacific regions and Latin America.

BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: DICRANALES: DICRANACEAE-SYMBLEPHARIS

15. Symblepharis reinwardtii (Doz. & Molk.) Lac.

Dioicous. Robust plants on tree trunks forming tufts, yellow-green above, brown below. Stem simple or branched, 3 cm. or more in height, thickly covered by red rhizoids in the lower part, crowded with erect-spreading leaves which are flexuose and curled when dry. Leaves \pm 7 mm. long; base erect, clasping, broad (\pm 1 mm.), narrower at point of attachment; sharply bends outwards and gradually narrows into a lanceolate-subulate, canaliculate tip; margins flat, denticulate to serrulate near tip, undulating at base. Costa deeper in colour, excurrent. Cells at extreme leaf base thin-walled, rectangular, up to 70 \times 12 μ , cells above it have sinuose walls and gradually become more and more incrassate upwards, \pm 36 \times 10 μ at mid-lamina, quadrate-rectangular (14 \times 9 μ to 9 \times 9 μ) at tip, at apex the marginal cells are elongated and dentate. Perichaetial leaves erect, more clasping with shorter lamini. Seta terminal (may become lateral by proliferation), erect or slightly bent, \pm 7 mm. long, light brown. Capsule brown, ovate-cylindrical, \pm erect, \pm 2.28 mm. long. Peristome teeth red-brown, dicranate, spreading out like rays when dry. Operculum conic-rostrate. Spores brown, warty, \pm rounded, up to 20 μ in diameter. Calyptra cucullate, entire at base.

Distribution: East Nepal, Darjeeling, Sikkim, Arunachal, Naga Hills, Lower Burma, Java, Borneo, Philippines, Taiwan. A South-East Asiatic species.

HAPLOLEPIDEAE. DICRANALES: DICRANACEAE: DICRANUM

16. Dicranum himalayanum Mitt.

Robust plants. Red-brown stem, often dichotomously branched, up to 4 cm. tall, densely covered with green, falcate (may be slightly flexuose in the upper part), patent leaves which may or may not be secund and do not change much when dry. Leaves lanceolate, up to 1 cm. long, narrowing down from a wider (\pm 1.2 mm. broad), sheathing base to a long, canaliculate upper part. Leaf margin smooth. Lower leaves smaller. Brown, narrow costa percurrent, smooth. Alar formed of large rectangular cells which do not bulge out, usually deep red-brown near margin and hyaline near costa. Basal lamina cells elongate rectangular (up to $55 \times 17 \mu$), brown, with porose, incrassate walls. Upper lamina cells similar but smaller (\pm 16 \times 5 μ). Seta brown, straight or slightly curved, apical (may appear lateral because of proliferation) up to 1.8 cm. long. Capsule red-brown, regular, ovate-cylindrical, erect or slightly nodding, up to 3.5 mm. long and 1.3 mm. in diameter. Operculum conic-rostrate, about half the capsule in length. Peristome teeth red-brown, regular dicranate with vertical striations. Spores brown, spherical, papillose, 18 to 29 μ in diameter. Fruiting in October.

Distribution: Western Himalaya, East Nepal, Sikkim, Darjeeling, Bhutan. An endemic Himalayan species.



BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: DICRANALES: LEUCOBRYACEAE: LEUCOBRYUM

17. Leucobryum sanctum (Brid.) Hamp.

Comparatively robust, brownish pale green epiphytic plants in tufts. Stems up to 3 cm. long, usually branched, without central strand. Leaves erect to erect-spreading, flexuose to secund, not much changed when dry; abruptly lanceolate-subulate from a wider, ± rectangular base, canaliculate above, shortly apirulate; mature leaves on vegetative shoots distinctly auriculate, up to 4 mm. (known up to 7 mm. in Java and Philippines specimens) long and ± 1 mm. wide at base. Leaves at top and base of vegetative shoots and most leaves on fertile shoots do not show auricles. Most of the leaf is a wide costa scabrous on back which is flanged by a very narrow lamina. The leaf tis, shows the costa to have an innermost layer of 4-angled chlorocyst cells sandwiched between 2 layers of transparent leucocysts. Hence the white colour of the plants. Leucocysts become several layered on the dorsal side and 2-layered on the ventral side at leaf base near attachment with stem. Leucocyst cells ±48 × 33 μ at upper part of leaf base becoming smaller towards base and towards margin. Lamina cells hyaline, rectangular, smaller than leucocyst cells, narrower and slightly more elongated at the border. Cells round the auricle smaller and 2-layered. Perichaetial leaves not auriculate, much smaller with a very broad base (± 2mm, long and 1 mm, wide at base), suddenly tapering from an ovoid base. Seta reddish, terminal but becomes lateral by proliferation, ± 1 cm. long with a horizontal, strongly strumose, more or less sulcate, asymmetrical capsule ± 1 mm. long and 0.75 mm, in diameter. Operculum conic-rostrate, bent to one side. Spores smooth, 10 to 12 µ in diameter.

Distribution: East Nepal, Darjeeling, Malay, Vietnam, Java, Borneo, Moluccas, New Guinea, Philippines, Fiji, Samoa, Australia. An Indo-Pacific species.

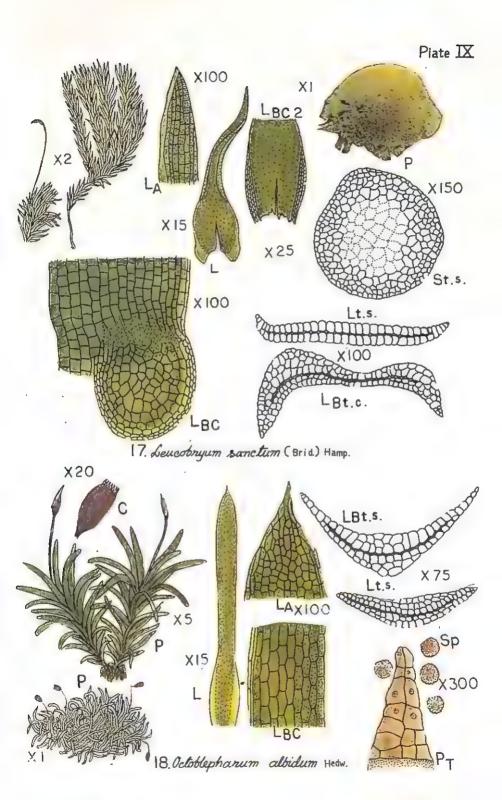
HAPLOLEPIDEAE: DICRANALES: LEUCOBRYACEAE: OCTOBLEPHARUM

18. Octoblepharum albidum Hedw.

Autoicous. Greenish white plants forming tufts on tree trunks, up to 2 cm. high. Stem without central strand and not branched. Leaves more or less crowded, erect-spreading on a very short stem, rigid, not changed when dry, usually forming a rosette near tip, \pm 5 mm. long, ligulate from a wider, concave, \pm sheathing base; more or less flat above, apiculate at tip where it may be minutely serrulate. Costa wide, smooth on back, forming most of leaf, with a median row of triangular chlorocyst cells sandwiched between 5 or 6 layers of leucocysts in the middle of the leaf and 2 or 3 layers in the sides. Leaf base flanked by 5 to 9 rows of hyaline linear cells of which the outermost 2 rows are formed of narrow linear cells which persist to the top of the lamina. Seta straight, apical, \pm 5 mm. long. Capsule erect, oblong-ovoid, symmetrical; urn \pm 0.8 mm \times 0.45 mm. Peristome teeth 8, yellowish, not split but showing a longitudinal median line, each 110 \times 67 μ at base, formed of short, rectangular cells. Operculum conical, 1/2 to 2/3 of urn in height. Calyptra cucullate, entire at base, reaching about two-thirds down the urn. Spores light brown, finely papillose, 19.5 to 21 μ in diameter. Fruiting in October in the Himalayan Terai.

Distribution: East Nepal, Sikkim, Darjeeling, Dooars, Lower Bengal near Calcutta, Orissa, Arunachal, Upper Assam, Manipur, South India, Ceylon, Burma, Thailand, Vietnam, Indonesia, Philippines, China, Hawaii, All over North & South America, Australia, North & Central Africa.

Cosmopolitan in tropical & subtropical countries.



BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: FISSIDENTALES: FISSIDENTACEAE: FISSIDENS

19. Fissidens ceylonensis Doz. & Molk.

Forming yellow-green turf covering steep banks (lateritic soil with sand or not) shaded by dry deciduous, open type *Shorea (shall)* forests. Plants often prostrate, up to 7.5 mm. long and 1.33 mm. broad. Up to 28 pairs (distichous) of leaves. Plants flat. Leaves flat (folded and curled, pressed to stem when dry), oblong-lingulate, broadest at base, suddenly apiculate from a broad base, up to 0.8×0.25 mm. Dorsal lamina base usually rounded. Sheathing lamini equal. Leaf apex symmetrical. Semilimbidium (3 rows at base, 1 row at top) of elongated pellucid cells covers most of the sheathing lamini border. This limbidium may be absent in some sterile plants. Costa greenish white, short excurrent. Leaf cells rounded hexagonal, up to $8.5~\mu$ diagonally, subobscure, multipapillate of punctate type (a few papilli project from the margin cells). Perichaetial leaves longer and narrower ($\pm 1 \times 0.18$ mm). Apical, light brown seta, ± 2.7 mm. long, usually geniculate. Capsule urn of same colour, $\pm 0.75 \times 0.4$ mm., ovate, slightly nodding or straight. Peristome teeth orange brown, dicranate, spirally thickened, ± 0.2 mm. high. Translucent spores 14 to 17 μ in diameter. Fruiting in late October in West Bengal lateritic area. Male flowers usually axillary on same plant.

Distribution: East Nepal, Darjeeling, Lateritic West Bengal, Western Himalaya, South India (Nilgiri, Palni, Ghais), Ceylon, Yunnan, Thailand, Vietnam, Malay, Sumatra, Java, Borneo, Moluccas, Philippines, New Zealand. An Indo-Pacific species.

HAPLOLEPIDEAE: SYRRHOPODONTALES: CALYMPERACEAE: SYRRHOPODON

20. Syrrhopodon gardneri (Hook.) Schwaegr.

Dioicous. Tufted, dull green, epixylic plants with usually simple, sometimes dichotomously branched stems without central stand, up to 1.3 cm. high. Leaves rigidly erectopatent to erect-spreading from a slightly wider, sheathing base narrowing to a ligulate, carinate lamina; curled with incurved margins when dry; up to 4 mm. long including the base which is about $\frac{1}{2}$ the total length, \pm 0.5 mm. wide at lamina and \pm 0.7 mm. at base; tip acute; margin sharply serrate from base to apex. Leaf edge with a triangularly thickened, double-toothed border from top of base to a little below tip but the border cells similar to lamina cells in appearance, except for the spinose projections. Cancellinae of 5 to 10 rows of large, hyaline, rectangular cells on each side of costa filling most of the base except a border of 3 to 6 cells of narrower elongated cells on each side; rounded on top. Chlorophyllose lamina cells ovate-quadrate, \pm 8.5 μ broad (slightly elongated below), papillose with a single rounded papilla on each cell at midleaf, obscure. Costa narrow, with a median row of deuter cells in cross-section, ending in a number of spines slightly below apex. Fruiting plants not seen. Copious development of elongated gemmae from leaf tips take place. The gemmae also show protonema-like growth *in situ* and young plants are seen to develop on leaf tips.

Distribution: East Nepal, Darjeeling, Bhutan, Khasia, Western Himalaya, Ceylon, Burma, Thailand Vietnam, Malay, Java, Borneo, Philippines, New Guinea. An Indomalesian species.



20. Synnhopodon gandneri (Hook) Schwaegr.

BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: SYRRHOPODONTALES: CALYMPERACEAE: CALYMPERES

21. Calymperes tenerum C. Muell.

Plants forming tufts of green epiphytic plants with stiff-leaves which soften on getting wet. Plants usually short with rosette-like spreading of tops. Stem simple up to 6.5 mm. high. Leaves erectopatent, \pm 2.5 × 0.5 mm., curled hook-like when dry. Normal leaves lingulate, base not broader than lamina, apex obtuse. Upper gemmae leaves longer and narrower at top, \pm 3 × 0.7 mm. (Sometimes the gemmae leaves show a spoon-like development of top within which some gemmae are hidden.) Chlophyllose lamina cells hexagonal to quadrate or short rectangular, with one or more coarse papilli on top. Leaf margin smooth at top, may be slightly denticulate at base. Cancellinae within leaf base, \pm 0.75 mm. high with about 10 rows of hyaline, rectangular cells on each side of the costa; cells very large near costa (\pm 130 × 37 μ) gradually becoming narrower towards margin and bordered by about 6 rows of elongated, very narrow cells at the margin; 2 submarginal rows of these cells are transparent forming short tenioli. Costa prominent, percurrent in normal leaves but excurrent into a club-like structure (which may branch by splitting in some cases) in gemmiferous leaves bearing radiating brood-bodies in star-like clusters. Gemmae multicellular, \pm 134 × 36 μ , green, germinating from tip forming protonemal threads. Not known in fruiting condition.

Distribution: Alluvial Lower Bengal (C. Muell. Type from Calcutta), common round Calcutta. South India (Tirunelveli), Vietnam, Malay, Sumatra, Java, Moluccas, New Guinea, Philippines, New Caledonia, Hawaii, Caroline Is., Gilbert & Marshall Is., Tonga, Samoa, Tahiti. An Indo-Pacific species.

HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: ANOECTANGIUM

22. Anoectangium thomsonii Mitt.

Dioicous. Sturdy, caespitose, terrestrial plants, yellow-green above, turning green to brown below. Stem brown, usually forked above, 2.5 cm. or more long, with reddish-brown hairs below, densely and uniformly covered by leaves. Leaves erectopatent to spreading, curled when dry, ovateranceolate with broader ovate base, up to 1.7 mm. long and 0.3 mm. wide at base, apex acute, margin smooth and usually flat, canaliculate at top. Costa prominent, reddish brown, percurrent. Lamina base cells brownish, rectangular to ovate-hexagonal at base, incrassate; upper lamina cells more chlorophyllose, incrassate, irregularly quadrate, papillose and often obscure. Perichaetial leaves on short, side shoot smaller, elliptic-elongate, imbricate. Seta erect, deep brown, \pm 1 cm. long-Capsule brown, erect, ovate, \pm 1.5 \times 0.8 mm., showing a short but distinct apophysis. Peristome not developed. Annulus of two rows of deeper coloured, horizontally elongated cells at mouth of urn. Spores spherical, brown, pellucid, 10 to 12.5 μ in diameter.

Distribution: Eastern Nepal, Darjeeling, Sikkim, Western Himalaya, Central India, South India, Japan, Siberia (Amur). A South and East Asiatic species.

BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: REIMERSIA

23. Reimersia inconspicuua (Griff.) Chen.

Lax tufts of yellow-green plants on rocks or trees often mixed with other mosses in very well situations. Stems often elongating by proliferation reaching a length of 10 cm., erect or slightly inclined, unbranched or more often branching dichotomously. Leaves lax, tristichous, squarrose, somewhat shrunk and patent when dry but not otherwise changed. Leaves a little wavy, lanceolate from a broadly ovate, erect, \pm sheathing base which is narrower and slightly decurrent at the point of attachment, extended into a sharp, pointed tip above, up to 3 mm. long and 0:9 mm. wide at base. Margin smooth and flat. Costa brownish green, strong, keel-like, extanded into a stiff, long, awn-like tip, smooth on back. Leaf base cells elongated rectangular, shorter near costa (\pm 28 × 14 μ) becoming longer (\pm 34 × 7 μ) near margin; leaf base middle cells are somewhat thickened with wavy, pitted walls; upper lamina cells irregularly quadrate to hexagonal, \pm 14 μ wide. All leaf cells transparent. Perichaetial leaves not differentiated. Sporophytes pseudolateral because of proliferation. Seta erect, brownish yellow, \pm 0.7 mm. long. Capsule erect, red-brown, ovate, up to 1.4 × 0.65 mm. Operculum conic long-rostrate, \pm 0.75 mm. high, beak bent to one side. Peristome not developed. Urn-mouth cells thick-walled. Spores light brown, pellucid smooth, 10.5 to 12 μ in diameter. Fruiting August to October.

Distribution: Darjeeling (Tiger Hill), Khasia (Cherrapunji), Western Himalaya, China (Yunnan,

Kiaochao), Taiwan, Japan, Philippines. A South and East Asiatic species.

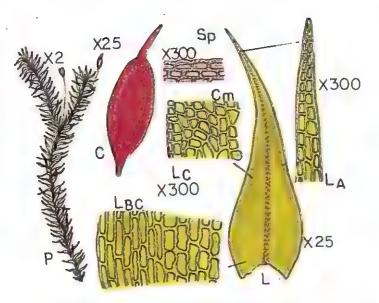
HAPLOLEPIDEAE: POTTIALES. POTTIACEAE: HYOPHILA

24. I 'ila involuta (Hook.) Jaeg.

Dioicc s. Both antheridial and archegonial shoots apical. Dense tufts of dark green plants of bricks, mortar, rocks and rarely soil. Erect (partly ascending), simple or branched shoots show a horizontal, radiculose part below, \pm 1 cm. high (may be 2 cm. counting the radiculose portion) with the top leaves spreading in rosettes. There are red rhizoids on stem which is uniformly covered by leaves. Leaves erect-spreading, curled circinately with the leaf margins inrolled when dry Leaves up to 3.3 \times 1 mm., oblong-lingulate, carinate; lower oblong part pale, sheathing and erect; apex broadly pointed; margin entire below, denticulate at apex. Costa red-brown, plano-concave, prominent, wider at base, percurrent. Upper lamina cells chlorophyllose, mamillose, lightly obscure rounded quadrate, 6 to 8 μ in diameter with a few larger cells at the marginal teeth. Leaf base cells pale, rectangular, wide-lighted, smooth, \pm 50 \times 20 μ , becoming smaller above. Perichaetial leaves not much differentiated, only shorter. Seta apical, erect, red-brown below, paler above, \pm 1.5 cm. long. Capsule cylindrical, brown, erect; urn up to 3.15 \times 0.56 mm. Annulus of 1 of 2 rows of very thick-walled, lenticular cells. Peristome not developed. Operculum conical, rostrate, \pm 0.85 mm. high. Calyptra cucullate. Spores dirty brown pellucid, spherical, 8.4 to 11 μ in diameter. Fruiting October-November.

Distribution: East Nepal, Darjeeling, Sikkim, Gangetic Bihar and Bengal, Lateritic Bengal, North Bengal, Chhotanagpur, Arunachal, Khasia, Upper Assam, Central India, Western Himalaya, North Indian Plains, all-over South India, Ceylon, Burma, Vietnam, East China, Manchuna, Korea, Japania, Taiwan, Philippines, Sumatra, Java, Celebes, Borneo New Guinea, Oceania, North-Central-South

America, Europe. Almost cosmopolitan.



23. Reimersia inconspicuua (Griff.) Chen



24. Hyophila involuta (Hook.) Jaeg.

BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: BARBULA

25. Barbula constricta Mitt.

Diolcous. Yellow-green to brownish, elongated plants, 1.5 to 3 cm. high forming dense tufts. Stem usually dichotomously branched, laxly covered by erect-spreading leaves which are flexuose and crumpled when dry Leaves ovate-lanceolate, carinate, up to 2.3 mm. long, gradually tapering from a wider (\pm 0.6 mm. broad) base to a subulate point; margin recurved, entire. Costa prominent, brown, smooth on back, percurrent or short excurrent. Lamina base cells hyaline, rectangular, smooth, up to 31 \times 9 μ . Upper lamina cells irregularly quadrate, \pm 8 μ wide, papillose, somewhat incrassate near margin. Perichaetial leaves erect. Seta erect, somewhat sinuose when dry, slender, red, apical but becomes lateral by innovations, \pm 1.5 cm. long. Capsule erect, brown, ellipticocylindrical, \pm 2.3 \times 0.65 mm. Peristome teeth filiform, papillose spirally wound for one turn, brown, \pm 1 mm. high. Operculum brown, conic-rostrate, \pm 1 mm. high. Spores spherical, smooth, pellucid yellow to brownish, 10 to 11.2 μ in diameter.

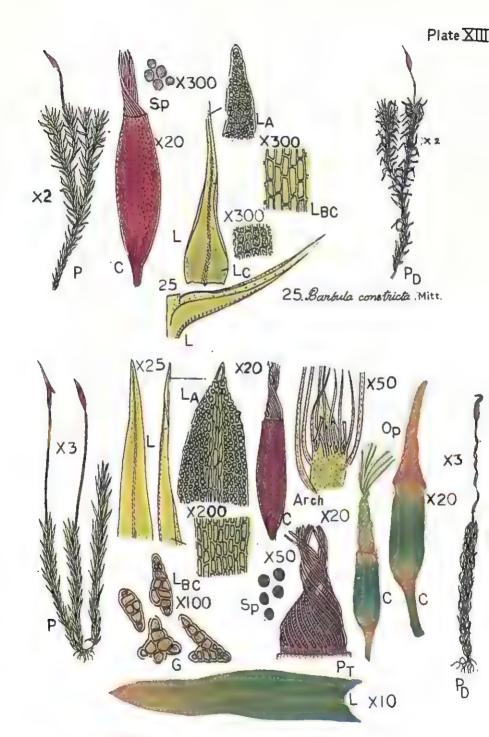
Distribution: Kashmir, Western Himalaya, Nepal, Sikkim, Darjeeling, Upper Burma, North & South China (including Yunnan), Japan, Java, Philippines. A South and East Asiatic species.

HAPLOLEPIDEAE. POTTIALES. POTTIACEAE: HYDROGONIUM

26. Hydrogonium arcuatum (Griff.) Wijk. & Marg.

Dioicous. Yellow-green, tufted plants, less stiff than *Barbula* and prefering alluvial soil. Stem about 1 cm. high, usually unbranched, uniformly covered with leaves. Leaves erectopatent (curved and crispate when dry), carinate-concave, \pm 2 mm. long and 0.5 mm. wide at base lanceolate from a broader, half-sheathing base. Margin entire, mostly flat. Leaf tip acute, pointed, there may be one or two denticulations at the extreme apex. Costa prominent, yellow-brown, percurrent or ending in a small point. All leaf cells usually smooth; basal ones elongated rectangular, pellucid, up to 34 \times 8 μ ; upper cells chlorophyllose, subquadrate, 6 to 12 μ wide, may sometimes show long, mixed with filamentous paraphyses up to 5.5 mm. long. Seta red-brown, apical, erect (twisted when dry), up to 1.4 cm. long. Capsule erect, brown, cylindrical, up to 2 \times 0.45 mm. Operculum conic-rostrate, about half as long as the capsule or longer, erect. Calyptra cucullate, covering only the tip of the capsule. Peristome teeth \pm 1 mm. high, filiform, papillose, spirally twisted 1 to more turns, red-brown. Spores round to oval, yellow pellucid to brown, 11.5 to 12.5 μ in diameter. Fruiting from September to November. Gemmae present in leaf axils, \pm 122 \times 72 μ , multicellular, oval to

Distribution Nepal, Darjeeling, Sikkim, Lateritic & Gangetic West Bengal, Arunachal, Khasia, Assam, Orissa, Central India, Kashmir, Western Himalaya, Upper Gangetic Plains, North & South Burma, Malay, Java, Moluccas, New Guinea, Philippines, China, Japan, Oceania. An Indo-Pacific species



26. Hydrogonium arcuatum (Griff.) Wijk. & Marg.

BRYIDAE: ARTHRODONTEAE: HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: SEMIBARBULA

27. Semibarbula orientalis (Web.) Wijk. & Marg.

Dioicous. Yellow-green to green, slender calcicole plants in dense tufts on old walls, mortar. etc. Plants may be rather short (± 5 mm.) to luxuriant (up to 2 cm. on water outlet lines), usually unbranched. Leaves lax (clustered near top), spiral, oblong to ovate-lanceolate, up to 1.5 mm. long and 0.32 mm. broad at the slightly wider base, erectopatent (incurved and curled when dry) carinate; margin papillose, unbroken, usually flat, apex blunt (broadly acute in some specimens). Leaf base covers the lowest quarter, not sheathing, cells elongated rectangular, hyaline, up to 42 x 8.4 µ. Upper lamina cells chlorophyllose, highly multipapillose, obscure, rounded-quadratehexagonal, up to 5 to 8 µ wide. Costa strong, light greenish yellow, percurrent or ending in a minute, hyaline apiculus, corrugated by coarse papillae; t.s. shows a supramedian row of four deuter cells, a large patch of dorsal and a smaller patch of ventral substereides. Perichaetial leaf not differentiated. Seta apical, reddish on top, erect, 4 to 7 mm. long. Capsule reddish brown, erect, cylindrical, up to 1 × 0.36 mm, in large plants. Brown peristome split into 32 short (± 360 µ high), filamentous segments (too short to twist spirally) covered with dense, minute papilli all over the surface. Operculum conic, short rostrate, ± 0.5 mm. high. Spores round, yellowish pellucid, smooth, 8.4 to 11.2 µ in diameter. Calyptra cucullate, covering the tip but reaching the middle of the urn. Fruiting, October-November. Multicellular gemmae abundant during the rains growing in apical as well as axillary clusters. Each gemma 60-80 x 25-36 µ.

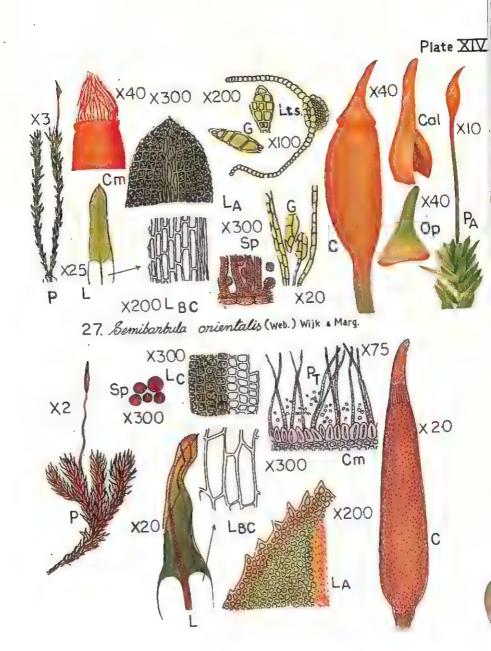
Distribution: Formerly called Barbula indica, this is the commonest moss in the Indian plains. Nepal, Darjeeling, North & Eastern Indian Plains (including Chhotanagpur, Orissa and the lateritic areas), Arunachal, Assam, Western Himalaya; Central, Western & South India; Ceylon, Burma, Indonesia, Philippines, Malaysia, Taiwan, South & East China, Japan, Central & South Africa, Oceania. Common in all Indian & Pacific Ocean countries.

HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: BRYOERYTHROPHYLLUM

28. Bryoerythrophyllum wallichii (Mitt.) Chen.

Dioicous. Reddish green to brown, caespitose plants. Stems usually branched, up to 1.5 cm long, thickly covered by leaves. Leaves patent to erectopatent, appressed to stem and mildly crispate when dry, lingulate from an ovate, half-sheathing base, carinate, up to 2.8 mm. long and 0.8 mm. broad at base. Margin usually reflexed at places, serrulate at tip. Costa red-brown, percurrent or ending in a short apiculus, keeled. Leaf base cells rectangular (up to $70 \times 20\,\mu$), smooth, transparent brown. Upper lamina cells reddish brown, chlorophyllose, irregularly quadrate (6 to 11 μ wide), densely multipapillose and obscure. Whole leaf bordered by 2 to 3 cells of non-chlorophyllose, quadrate, smooth, pellucid brown cells. Leaf tip broadly pointed. Perichaetial leaves narrower with acute apex. Seta red-brown, apical, becomes lateral by innovations, erect but spirally flexuose, \pm 1.4 cm. long. Capsule red-brown, cylindrical but tapering towards tip, \pm 3.2 \times 0.8 mm. Operculum conic-subulate, \pm 1 mm. long. Peristome teeth brown, each split to base into two papillose, erect, filaments, \pm 340 μ high. Annulus present, formed of incrassate, lenticular cells, light brown. Spores brown pellucid, smooth, 11.2 to 15.4 μ in diameter.

Distribution: East Nepal, Sıkkım, Western Hımalaya, Kashmir, Gılgit, Central Asia. A Hımalayan-Central Asiatic species



28. Bryoerythrophyllum wallichii (Mitt.) Chen.

8RYIDAE: ARTHRODONTEAE HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: *MERCEYA*

29. Merceya' ligulata (Spruc.) Schimp.

Dioicous. Yellow-green to green (becoming brown in older parts) plants in dense tufts growing on siliceous rocks containing copper (or iron). Hence, they are called 'copper mosses' indicating presence of copper. Stem brown, more or less triangular, up to 2 cm. tall, covered by erectopatent leaves which are more crowded at the apex, radicle and stem surface tomentose, often branched from base. Leaves soft with undulating margins, carinate and curled when dry, fails to come back to original shape without boiling; brightly ligulate from a narrower base, ± 3.6 mm. long and 1.2 mm. broad at the upper region; apex broadly rounded, margin entire. Costa light brown, ends below tip vanishing with the thicker leaf border. Basal leaf cells large rectangular (\pm 120 \times 60 μ) with thin brownish walls, lax and transparent, forming cancellinae covering the lower half of the leaf. In the upper half, there are about 5 to 6 rows (more rows at the tip) of incrassate, irregularly quadrate, $\pm 8\,\mu$ wide cells with green walls forming a complete border for this part of the leaf; inner lamina cells gradually increasing in size from margin to costa and from tip to base, thin-walled, inner cells at middle of lamina \pm 15 μ wide; all upper cells with minute papilli. Seta terminal (may become lateral because of innovations), erect, red-brown below, greenish yellow above, ± 6 mm. long. Capsule erect, oval, $\pm 1.44 \times 0.61$ mm., light brown. Operculum conic-rostellate, ± 0.36 mm. high. Peristome not developed but prominent annulus present. Calyptra cucullate. Spores smooth brown (sometimes appear to be finely papillose), 11.2 to 13.3 μ in diameter. While the species does not fruit in Europe and fruits rarely in China or Japan, it fruits copiously in Darjeeling in August pointing out that it is probably its natural ancestral home.

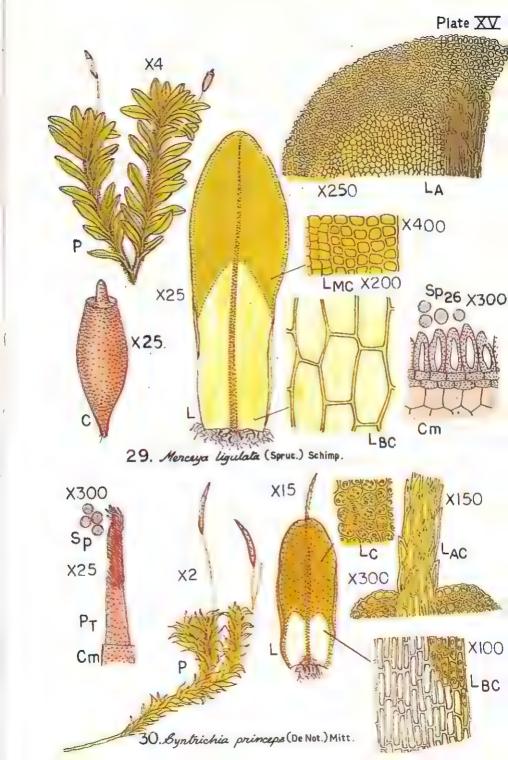
Distribution: East Nepal, Darjeeling, Western Himalaya, Europe, Azores, Caucasus, Asia Minor, China, Japan, Philippines, Java, North, Central & South America, North Africa, Almost

HAPLOLEPIDEAE: POTTIALES: POTTIACEAE: SYNTRICHIA

30. Syntrichia princeps (De Not.) Mitt.

Synoicous. Sturdy, dichotomously branched, green plants up to 4 cm. long with the base sometimes bare. Leaves progressively increasing in size towards tip, red rhizoids grow from the base of leaves. Leaves erectopatent (spreading at the tips), flexuose and more appressed to stem when dry, often in interrupted rosettes, up to 4.55 mm. long with transparent awn up to 1.5 mm. long, broadly oblong-elliptic, \pm 1.9 mm. wide; apex rounded, obtuse, slightly emarginate; margin revolute to about $\frac{1}{2}$ height of leaf. Costa strong, brown, excurrent in the transparent, mildly spinose (spine cells \pm 84 \times 14 μ) awn. Leaf base cells transparent, smooth, up to 140 \times 15 μ near costa base, borders at margin by a narrow extension of lamina cells. Lamina cell chlorophyllose, multipapillose with horseshoe-shaped and round papilli, somewhat obscure, irregularly rounded-quadrate, mildly collenchymatous (at top) 11 to 17 μ wide; marginal rows-flattened. Perichaetial rows not separated. Setae apical on branches (may become lateral), several on each plant, erect or slightly curved, golden brown, \pm 1.8 cm. long. Capsule erect or nodding, slightly curved, deep brown, \pm 2.5 mm. high. Peristome rising from inside the urn, \pm 1.75 mm. high, brown, forms a cylindrical tube up to more than half the height and then splits into spirally twisted filaments with tips paler in colour. Spores light brown, pellucid, 9.8 to 11.2 μ in diameter.

Distribution: Alpine Sikkim, Western Himalaya, Europe, Caucasus, Central Asia (Taiikstan), Australia, New Zealand, North Africa; North, Central & South America, Oceania A cosmopolitan



BRYIDAE: ARTHRODONTEAE HAPLOLEPIDEAE POTTIALES. POTTIACEAE: LEPTODONTIUM

31 Leptodontium viticulosoides (P. Beauv) Wijk, & Marg.

Dioicous. Robust, yellow-green plants in loose tufts. Stems usually branched from base, erect, up to 4 cm. high with the lower part covered by red-brown tomenta, uniformly covered by leaves. Leaves squarrose to erectopatent (erect and irregularly flexuose when dry), carinate, ± 3.6 mm ong and 1 mm wide at base, base sheathing and wider, narrowing above forming an ovate-lanceolate body, apex sharply acute; margin smooth and often inrolled at base, serrulate in the upper half. Costa light brown, vanishing at tip. Leaf base cells elongated rectangular (up to $78 \times 11.2~\mu$), thin-walled to lightly incrassate, smooth and pale, becoming shorter, thick walled, strongly chlorophyllose and multipapillose above, upper lamina cells rounded-quadrate ($\pm 12~\mu$ wide), incrassate and multipapillose. Perichaetial leaves cylindrically sheathing, erect. Seta terminal, often lateral due o innovations, brown, ± 2 cm. long, erect. Capsule brown, usually erect, cylindrical from an ovoid base, ± 3.3 mm. long and 0.9 mm. wide at base. Urn rim of 5 to 6 rows of small, highly incrassate sells. Operculum conic-rostrate, ± 1.3 mm. high. Peristome inserted below the narrow urn mouth; eeth reddish brown, smooth, articulated, narrow, showing a tendency of splitting but not split, $\pm 145~\mu$ high. Spores brown, finely papillose, 18 to 25 μ in diameter.

Distribution: East Nepal, Sikkim, Bhutan, Khasia, Naga and Garo Hills, Java, Philippines, New Buinea, Taiwan, Abyssinia Central & South Africa, Madagascar, Reunion; North, Central & South

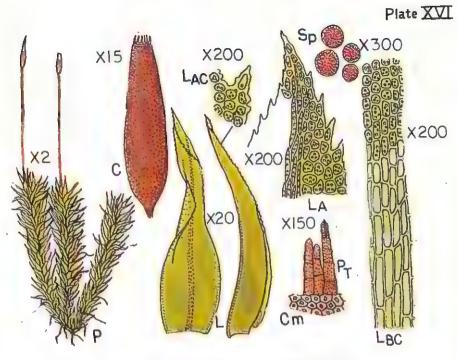
America. Almost cosmopolitan (except Europe & Australia)

HAPLOLEPIDEAE GRIMMIALES. GRIMMIACEAE: COSCINODON

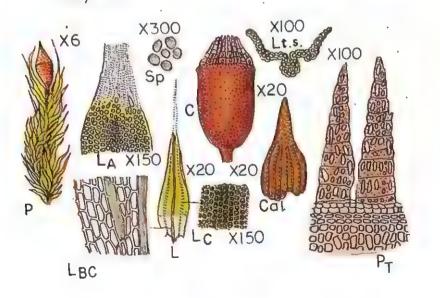
. Coscinodon cribrosus (Hedw.) Spruc

Plants dense caespitose, hoary (because of transparent leaf tips) above, greyish green below, mali (\pm 76 mm, high with extended leaves), often branched. Leaves erect to erectopatent (appressed to stem when dry), ovate-lanceolate, upper leaves with transparent awns, \pm 172 × 0.44 nm., transparent awn in upper leaves may be 0.75 mm, or more long, concave and keeled with hree keels formed by the central costa and two additional costas running parallel to it almost through he whole length of the leaf, margin unbroken, inrolled cucullate on top. Leaf base cells rectangular, iellucid, not sinuose, up to $38 \times 15~\mu$, upper lamina cells quadrate, chlorophyllose, \pm 9 μ wide, lightly sinuose at middle by irregular swelling of the walls. Awn cells smooth, elongated, hyaline, artilag nous, long, \pm 8 μ wide. Sporophyte erect, apical, immersed with a small seta (\pm 1 2 mm.). apsule urn-shaped, wide-mouthed, \pm 1 32 × 0.92 mm. Peristome \pm 120 μ high, formed of undivided, eve-like perforated, orange-red, lanceolate teeth. Operculum conic-rostrate. Calyptra campanulate, incate, \pm 1 6 mm. high. Spores rounded to oval, translucent, 9.5 to 11.5 μ in diameter.

Distribution Kashmir, Darjeeling (Phalut), Europe, Caucasus, Arctic Siberia, Japan, North Africa, Arctic, North America, Greenland A North Hemisphere albine species



31. Saptodontium viticulosoides (P. Beauv.) Wijk. & Marg



32. loscinodon cribrosus (Hedw.) Spruc.

BRYIDAE: ARTHRODONTEAE HAPLOLEPIDEAE: GRIMMIALES: GRIMMIACEAE: GRIMMIA

33. Grimmia ovalis (Hedw.) Lindb.

Small, caespitose, unbranched plants about 8 mm. high (sometimes taller, hoary only at top). Leaves compact, erect to erectopatent, much more appressed to stem when dry, ± 2.35 mm. long in the upper leaves including an erect, transparent tip about 1/4 the total length of the leaf; lower leaves do not show the transparent tip, lancequate, acute, carinate from an obovate, concave ± 0.56 mm. broad base; margin unbroken, thickened above, usually flat, percurrent below the transparent tip but rather obscure in the upper half of the leaf; basal cells pale, with thin walls, $\pm 28 \times 7 \,\mu$ near costa, shorter and broader (\pm 20 \times 14 μ) at middle with faintly sinuose walls; about 3 rows of much longer, narrower (up to $42 \times 8\,\mu$), transparent cells at the margin form a hyaline border at the base. Upper cells become shorter rectangular (\pm 14 × 10 μ), chlorophyllose with incressate, sinuose walls. Cells towards tip are short, round-quadrate, with incressate sinuose walls, 6 to 9 μ wide, rather obscure, two layers in thickness. Cells in transparent tip large, transparent, irregularly rectangular. Perichaetial leaves erect, much longer than normal leaves with longer transparent tips. Seta apical, erect, short (just exserting the capsule), brown, ±14 mm. long. Capsule erect, brown, smooth, ovate-cylindrical with wide mouth, $\pm 0.95 \times 0.28$ mm. Operculum conic long-rostrate, often with beak as long as capsule. Peristome teeth brown, irregularly 2 or 3-pronged.

Distribution: Kashmir, Western Himalaya, Nepal, Sikkim, Khasia, South India (Nilgiri, Palni), Ceylon, Central Asia (Tajikstan), Western Tibet, China (incl: Yunnan), Korea, Japan, Europe, Caucasus, North-Central-South Africa, North-Central-South America, Oceania, Australia. A

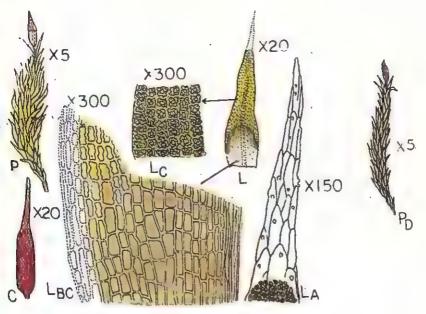
cosmopolitan species.

HAPLOLEPIDEAE: GRIMMIALES. GRIMMIACEAE: RACOMITRIUM

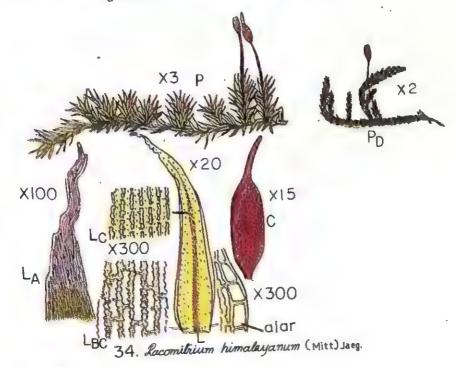
34. Racomitrium himalayanum (Mitt.) Jaeg.

Creeping, caespitose, prostrate plants (more than 3 cm. long) giving rise to very short (± 3 mm.) to medium (± 1 cm.), erect side branches covered by erectopatent to falcate leaves which are appressed to stem when dry. Leaves up to 3 325 mm. long and 0.525 mm. wide at base, ovate at base, lanceolate above, ending in a short, hyaline, flexuose tip, margin recurved almost throughout leaf length. Costa pale brown, percurrent, carinate. Hyaline flexuose tip formed of elongated, transparent cells, wide at base Lamina cells with highly incrassate, sinuose longitudinal walls with narrow lumens 14 to $50 \times 5~\mu$. Cells at extreme base wider, up to $56 \times 11~\mu$, paler in colour. A few rectangular, hyaline (\pm 28 \times 14 μ) cells at alar region with smooth walls. Sporophytes on the short side shoots. Perichaetial leaves erect, convolute, without hyaline tips. Seta erect, brown, 6 to 10 mm. long Capsule brown, erect, $\pm 1.85 \times 0.74$ mm. Operculum conic, long rostrate with a short base, ±1 mm. high, shortly bent to one side.

Distribution: Western Himalaya, East Nepal, Temperate and alpine Sikkim, Darjeeling. A species endemic in the Himalayas.



33. Grimmia ovalis (Hedus) Lindb.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: FUNARIALES. FUNARIACEAE: PHYSCOMITRIUM

35. Physcomitrium cyathicarpum Mitt.

A very beautiful moss quite common round about Calcutta and the North Indian plains generally. Plants small but sturdy, caespitose, often forming wide, bright green patches. Stem short, slender, erect, often branched at base. Shoot with branch ± 4.5 mm. Lower leaves smaller. Upper ones clustered, erect spreading in both dry and wet conditions, $\pm 3.6 \times 1$ mm., oblong ovate, acuminate, margin serrulate above. Costa strong, percurrent in upper leaves, may end below apex in lower smaller leaves. Basal leaf cells thin-walled, rectangular, up to $180 \times 40~\mu$. Upper, cells become narrower and shorter, $\pm 90~\mu$ long, becoming hexagonal or rhomboidal at top; border cells not differentiated. Seta slender, short, not exserting the capsule, ± 0.6 mm. high. Capsule globose, ± 1 mm., with a neat, brightly coloured (purple to orange), apiculate operculum. Calyptra small, captike (not cucullate) with a narrow, awn-like tip, not lobed at base. Exothecial cells hexagonal, thinwalled to collenchymatous. Spores bright red-brown, round or slightly fattened, warty papillose, 24 to 28 μ in diameter. Peristome not developed by degeneration from Funaria-type to which it is clearly related in the gametophyte.

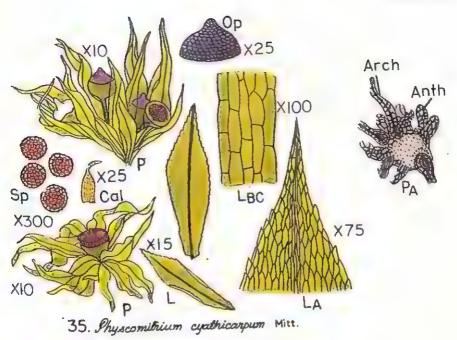
Distribution: Punjab (Ferozepur), Delhi, Rajasthan, U.P., Himalaya (Ranikhet), East Nepal (Terai), Bihar, Gangetic South Bengal (common on undisturbed, shady, garden soil and in flower pots in Calcutta and surrounding areas). A North Indian species.

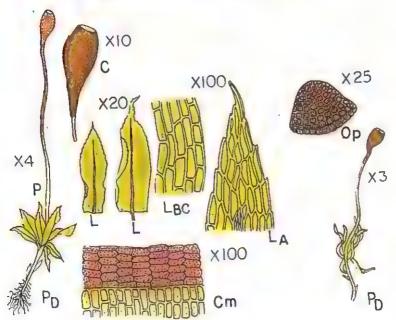
DIPLOLEPIDEAE: FUNARIALES: FUNARIACEAE: ENTOSTHODON

36. Entosthodon wallichii Mitt.

Laxly gregarious to tufted green plants resembling miniature *Funaria* to which genus it was once transferred. Plants small, ± 6 mm. high. Few small, lax leaves on lower stem, larger leaves forming a rosette at top, spreading out, crumpled and clinging to stem when dry. Leaves obovate-lanceolate to oblong-lanceolate, up to 1.5×0.5 mm., apex prolonged into a sharp point, margin usually dentate in the upper part. Costa ending a little below apex. Leaf cells thin-walled, large rectangular ($\pm 100\times20~\mu$) at base, narrower and hexagonal to rhomboidal at apex ($\pm 76\times10~\mu$); narrow tip of leaf farista) ± 0.18 mm. long; leaf marginal cells with pointed ends causing very mild dentation at apex. Seta apical, erect, ± 1.4 cm. long, flexuose, reddish brown on top. Capsule erect to slightly inclined, symmetrical, elongated pyriform with a tapering apophysis almost as long as the urn, ± 3 mm. high (with the apophysis) and 1 mm. in diameter at the urn, urn mouth narrower. Exothecial cells vertical rectangular, the rim is formed of about 5 rows of tinted, horizontal cells probably representing the annulus. Teeth not developed. Operculum conical convex. There are reports of the presence of some rudimentary teeth and frequent reports of a rudimentary apiculus on the operculum which only point out to a phase of evolution of this species.

Distribution: Western Himalaya (Tehni), East Nepal, Darjeeling, Khasia Hills (Mawflong, Myrung, Elephant Falls). An Indo-Nepalese species.





36. Entosthodon wallichii Mitt.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: FUNARIALES: FUNARIACEAE: ÉUNARIA

37. Funaria hygrometrica Hedw.

A variable species of loosely to closely tufted, green to yellow-green plants, simple or branched from base, usually about 1 cm. high. Lower leaves small, lax, showing poor development of costa. Upper leaves large, forming a rosette on top, oblong-obovate to oblong-lanceolate, concave, erect-spreading (much shrunk when dry), 2.5 to 4 mm. long 0.9 to 1.4 mm. broad, margin entire (except at tlp), apex acute, acuminate. Costa strong, percurrent or short excurrent in the upper leaves. Lamina cells thin-walled, rectangular to subhexagonal, more elongated ($\pm 108 \times 27$ μ) at base, smaller ($\pm 40 \times 20$ μ) at apex; marginal row narrower (± 10 μ wide), almost smooth but may cause fine indentations at tip. Seta apical, erect, strongly arcuate (there are variations which are straight erect and not arcuate). Capsule horizontal to pendulous, arcuate-pyriform, asymmetrical with an oblique narrower mouth, ± 4 mm. long with an apophysis and up to 2 mm. in diameter in the urn, yellow (becomes brown with age) with a deep red mouth, often sulcate when dry. Peristome teeth typical epicranoid; outer 16 brown, spirally arranged, ± 580 μ high and 90 μ wide at base; inner 16 hyaline, almost of same height, juxatoposed below the upper; apices of teeth united to a small central disc. Spores rather small, 9 to 16 μ in diameter. Autoicous. A male branch shown in plate.

Distribution: Numerous collections all over the Himalayas and the connected mountains and hills (Afghanistan, Kashmir, Nepal foothills, Manipur, Naga Hills, Jalpaiguri Dooars), Chhotanagpur (Parashnath), High Orissa Hills, the Ghats, Nilgiri, Palni, Ceylon, Burma, Thailand, Tibet, China, Taiwan, Korea, Japan, Siberia, Europe, North & South America, Africa, Australia, New Zealand, Oceania. A cosmopolitan species.

DIPLOLEPIDEAE: FUNARIALES: SPLACHNACEAE: GYMNOSTOMIELLA

38. Gymnostomiella vemicosa (Hook.) Fleisch.

Dioicous. Delicate plants in small patches or thick turfs on walls, mortar etc. Sterile plants up to 2 cm. long with filiform stem bearing leaves distantly and similarly placed club-shaped, multicellular gemmae (\pm 220 × 73 μ). Such gemmae are also found on the rhizoids of these plants. The distant leaves on these sterile plants are very minute (\pm 0.2 × 0.06 mm.), obovate, concave, erectopatent to erect-spreading (crumpled and appressed to stem when dry), margin of leaf entire but rough, warty in the upper half; apex rounded; costa weak, ending near midleaf; basal cells elongated rectangular, smooth, hyaline, \pm 20 × 8 μ ; upper cells quadrate to hexagonal, \pm 10 × 10 μ , with firm yellowish walls, sparsely warty papillose. Female plants very minute with stem 1 to 2 mm. high and larger perichaetial leaves clustered together. These leaves are spathulate, \pm 0.72 × 0.15 mm., with apex and costa as on sterile plants. Seta erect or a little curved, \pm 4 mm. high with an oval and without apophysis. Operculum long rostrate, curved to a side. Calyptra conical, split on one chymatous, hexagonal cells. Peristome not developed. Spores irregular, papillose, yellow-brown, 9 to 12 μ in diameter.

Distribution: East Nepal, Gangetic South Bengal (Calcutta and adjoining districts—all sterile, gemmiferous), Chhotanagpur (Ranchi—copiously fertile), Bastar (Central India) Ghats, Western Himalaya, Uttar Pradesh, Western Ghats, Burma, Singapur, Java, Amboina, Philippines, Riukiu Is. A South and East Asiatic species.

Plate XIX

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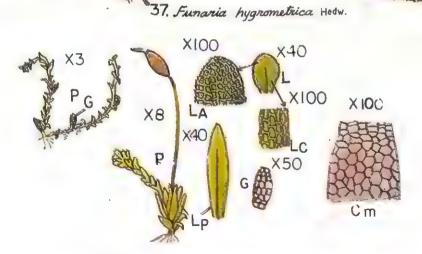
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38. Gymnostomiella vernicosa (Hook.) Fleisch

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: FUNARIALES: SPLACHNACEAE: TETRAPLODON

39. Tetraplodon angustatus (Hedw.) B.S.G.

Small to large, pale green (lower portion reddish tomentose) plants in dense tufts on rocks Sikkim plants are small (about 5 mm. long) and unbranched; but are known to be much longer (5 cm or more) and branched in Europe. Autoicous with sparsely leaved male shoot on side. Female shoots with large, closely placed leaves. Leaves erect (contorted and appressed to stem when dry), long lanceolate, 3 to 5 \times 0.6 mm., gradually become acuminate, tapering into a long, flexuose subula, carinate; margin entire at base, sharply spinulose-serrate above. Costa yellowish, strong, forming the greater part of the subula. Leaf cells rectangular (\pm 64 \times 15 μ), thick-walled at base, shorter rectangular (\pm 57 \times 19 μ) upwards, finally rhomboid-hexagonal. Perichaetial leaves larger. Seta pale, very short, erect, \pm 5 mm. long, just exserting the capsule. Capsule erect, \pm 4 mm. long and 2 mm in diameter, pale reddish, elongated pear shaped with somewhat wider hypophysis, contracted below mouth. Peristome deeply inserted, teeth 16 in one ring, \pm 0.39 mm. high, reddish yellow, hanging down on the outside. Spores 9.5 to 13.3 μ in diameter.

Distribution: Alpine Sikkim (4000-4300 m.), Europe (incl. U.K. & U.S.S.R.), Siberia, China (Yun-

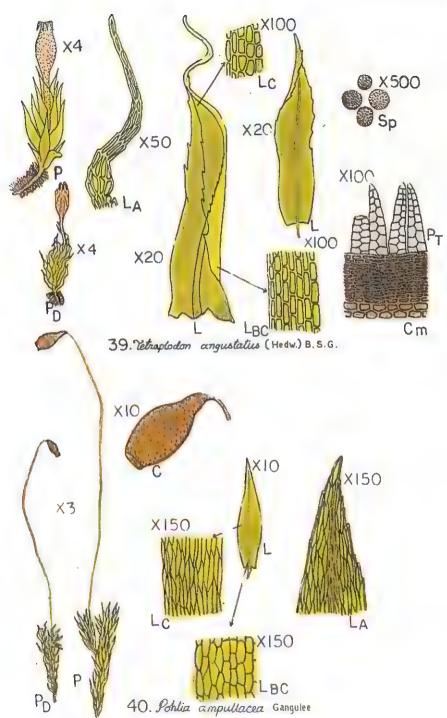
nan), Korea, Japan, North America. A North Hemisphere species.

DIPLOLEPIDEAE: EUBRYALES: BRYACEAE: POHLIA

40. Pohlia ampulacea Gangulee

Plants erect, loosely tufted, branched, about 1 cm. high. Leaves erect (flexuose when dry) narrowly ovate-lanceolate, narrower and decurrent at base, \pm 3.25 mm. long and 0.75 mm. wide at middle, apex apiculate; margin flat, entire, very mildly denticulate at tip. Costa percurrent or very shortly excurrent. Leaf cells at tip linear, some of them vermiculate, \pm 63 \times 7 μ . Middle leaf cells elongate, narrowly hexagonal, \pm 76 \times 13.5 μ , narrower at border (\pm 76 \times 7 μ). Leaf base cells broad rectangular, some of them irregular, 43 \times 20 μ to 56 \times 16.5 μ . Seta apical, erect but \pm arcuate at tip, \pm 3.5 cm. long. Capsule horizontal or drooping, pyriform bottle-shaped (ampullaceus), \pm 3 mm. long (with the narrow apophysis which is only one quarter of this length) and 1.5 mm. in diameter at the middle of the urn. Peristome structure destroyed in the specimen.

Distribution: Only specimen collected by Kurz from Darjeeling (2000 m.). Endemic in this area-



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: EUBRYALES: BRYACEAE: BRACHYMENIUM

41. Brachymenium ochianum Gangulee

Plants medium-sized, densely tufted, greenish vellow above, brownish vellow. Stem erect, densely clothed with leaves, tomentose below, red, about a cm. high, with two or more subfloral innovations. Lower leaves smaller. Upper leaves tufted, erectopatent (contorted and appressed to stem when drv), oblong-spathulate, 2.5 to 4 mm. long and ±1 mm, broad, acuminate in a long. arista: margin entire and revolute from base to % of leaf, dentate and flat above. Costa strong, excurrent in the ±0.37 mm. arista, reddish at base, vellowish green above. Leaf cells thin-walled, rhomboid and up to 50 x 16.5 u at apex. +66 x 18.5 u at middle of leaf; rectangular to subrectangular (up to $66 \times 26.5 \,\mu$) at base; there are 2 to 3 rows of narrow, elongated cells (\pm 96 \times 10 u at apex. + 160 × 10 u at midleaf forming a clear border which is reduced to 1 or 2 rows of shorter rectangular cells (±33×15 µ) at base. Perichaetial cells narrower and shorter, ±2.5 mm. long and 0.5 mm. broad. Seta apical, erect, red 2 to 2.5 cm. long. Capsule erect, orange-brown, ovate-cylindrical, 4 to 5 mm. long including a tapering apophysis about a quarter of this length and ± 1.2 mm. in diameter at the urn. Capsule mouth narrow. Operculum conical. Exothecial cells irregularly rectangular with wavy walls $\pm 140 \times 22 \,\mu$ and about 3 rows of small, quadrate cells forming the urn rim. Peristome teeth inserted below mouth; outer teeth $\pm 300 \,\mu$ high and $60 \,\mu$ wide at base, hyaline papillose at apex; inner peristome imperfect, represented only by a basal membrane, ± 120 µ high. Spores lightly papillose, 19 to 22 µ in diameter.

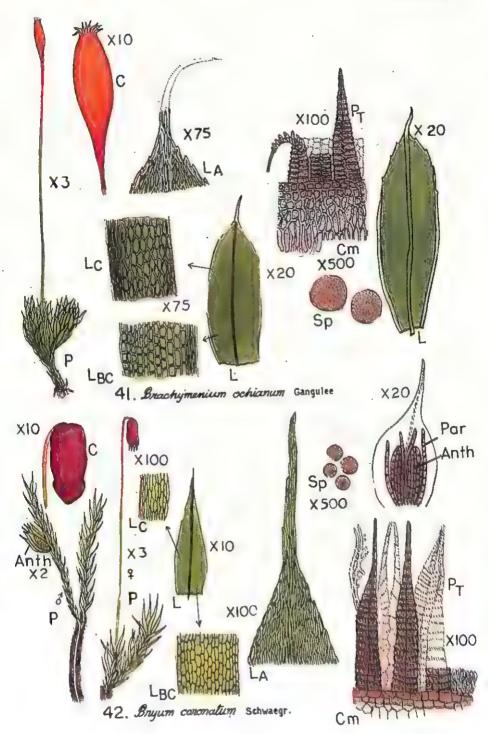
Distribution: East Nepal, Darjeeling, Bhutan, Taiwan. An Indopacific species.

DIPLOLEPIDEAE: EUBRYALES: BRYACEAE: BRYUM

42. Bryum coronatum Schwaegr.

Plants densely tufted, slender, growing on damp walls, bricks or calcareous soil, bright to dull green, tomentose at base. Stem often branched at base, up to 2 cm. high, with a central strand. Lower leaves smaller. Upper leaves ovate- to oblong-lanceolate, erect to erectopatent, lightly contorted when dry, long acuminate, $\pm 4 \times 1$ mm. Margin entire, flat. Costa strong, reddish at base, excurrent in a mildly denticulate arista ± 0.5 mm. long. Uppermost leaf cells thin to thick-walled, narrow rhomboid to hexagonal, $\pm 57 \times 8~\mu$; basal cells shorter, $\pm 39 \times 15~\mu$; without any marginal border though 1 or 2 marginal rows at base are narrower. Perichaetial baves shorter, triangular. Seta apical, erect but arcuate at tip, red to purple, up to 3 cm. long, vaginula ovoid. Capsule red to purple, pendulous, thick, shaped like a cup within a cup, $\pm 2.5 \times 1$ mm.; the basal part is a thick, spongy apophysis shorter than capsule and provided with stomata. Capsule mouth wide. Operculum big, conical. Annulus 2-3 rowed. Peristome reddish, $\pm 500~\mu$ high; outer teeth broad, lanceolate with sharp, hyaline papillose tips; endostome metacranoid, transparent yellow, as high as exostome, finely papillose, with 2 to 3 appendiculate cilia. Spores 7.6 to 11.4 μ in drameter. Dioicous. Male plants slender, long, antheridial bud becomes pseudolateral by innovations; antheridia large, numerous with many long, filamentous paraphyses.

Distribution: East Nepal, Sikkim, Darjeeling, Calcutta (now disappeared), Howrah & Hoogli, Burdwan, Midnapore, Orissa, Andaman. Found throughout India. Cocos Is., Thailand, Taiwan, Japan, Java, Philippines etc., Central & South Africa, North-Central-South America, Oceania, Australia. Cosmopolitan in tropical to warm temperate regions of the world.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: EUBRYALES: BRYACEAE: RHODOBRYUM

43. Rhodobryum giganteum (Schwaegr.) Par.

Plants very large, robust, in loose tufts, growing on humus soil and also on logs in forest shade, bright yellow green (brown below, with creeping subterranean stolons). Stem erect, usually branched by subapical innovations, about 6 cm. high with small (± 5 mm. long), scaly, appressed leaves on the lower stem and a rosette of very large leaves forming the crown. Leaves spreading (flexnose, crumpled and erect or spreading when dry), up to 1.5 cm. \times 2.5 mm., spathulate from a narrower base; margin often recurved below and flat above, entire below, spinose-denticulate with biseriate teeth above. Costa stout below, gradually becoming narrower above, may or may not reach the apex. Leaf cells thin-walled, lax, hexagonal to rhomboid, \pm 100 \times 20 μ at apex; distinct border of about 2 layers of elongated cells and teeth in pairs; basal cells rectangular, as long as upper cells. T.s. of costa shows begleiter cells but no stereide cell. Perichaetial leaves narrower, shorter. Seta apical, usually more than one, erect but arcuate at tip, up to 5 cm. high. Capsule reddish brown, oblong-cylindrical, slightly curved, \pm 9 \times 2 mm. with a short apophysis. Peristome as in *Bryum*. Operculum conical.

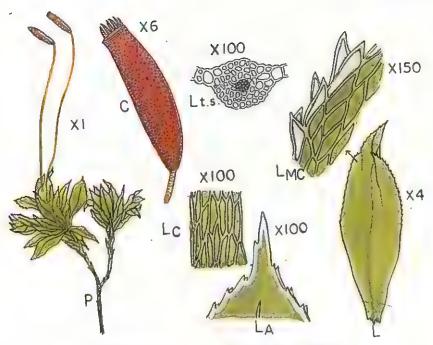
Distribution: East Nepal, Sikkim, Darjeeling, Khasia, Arunachal, Manipur, Western Himalaya (Garhwal), South India (Palni), Ceylon, Burma, Thailand, Annam, Laos, Sumatra, Java, Borneo, South China, Taiwan, Japan, Hawaii, Madagascar, An Indo-Pacific species.

DIPLOLEPIDEAE: EUBRYALES: MNIACEAE: MNIUM

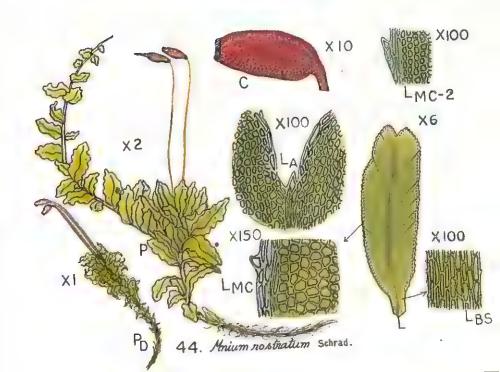
44. Mnium rostratum Schrad.

Plants yellow-green to dark green forming loose or compact creeping mats. Main stem erect, 2 to 4 cm, high; lateral sterile branches from the comal region or the stoloniferous base are prostrate or arched and may be creeping. Leaves on fertile, erect shoot more crowded at apex, spreading (curled and crumpled when dry), large usually oblong (may be ovate), usually notched at tip (may be rounded) but showing a small apiculus at the floor of the notch, suddenly narrowed at base, slightly decurrent, undulated, up to 9.6 × 2.9 mm.; margin flat, strongly bordered, with teeth in one row almost to base. Sterile shoots almost complanate with leaves in two rows. Costa red, percurrent or excurrent in the apiculus. Leaf cells thick-walled to collenchymatous, irregularly quadrate-hexagonal (15 to 26 μ wide) at top and middle, rectangular and subrectangular (\pm 61 x 26 µ) at extreme base; a row of larger, longer, rectangular guide cells are usually present on both sides of the costa; 2 to 3 rows (rarely 4) of narrow, elongated cells (up to $132 \times 7 \mu$) form a clear border with 1 to 3 (usually 2) celled spines in one series. Perichaetial leaves largest, 2 to 3 apical setae rise from each perichaetium. Setae red, erect (may be flexuose) but ±arcuate at tip, usually about 2 cm. long. Capsule horizontal to pendulous, yellow to light brown, ovate-oblongcylindrical, 2 6 to 5 x 1.5 to 2 mm., with a short apophysis. Operculum long rostrate (± 1.6 mm. long), straight or curved, beak red. Peristome Bryoid (as in Bryum), ±550 µ high. Dioicous or synoicous.

Distribution: All over the Himalayas (Kashmir to Khasia, Manipur & Naga Hills), South India (Nilgiri, Palni), Ceylon, Burma, Indonesia, Philippines, Taiwan, China, Korea, Japan, Kamchatka, W. Tibet, Europe, whole of Africa, North & South America, Asustralia, New Zealand. A cosmopolitan plant.



43. Rhodobryum giganteum (Schwaegr.) Par.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: EUBRYALES: BARTRAMIACEAE: BARTRAMIA

45. Bartramia halleriana Hedw.

Plants tall, in dense tufts, 6 to 10 cm. high, bright green above, brown tomentose below. Stem erect, slender, long, densely covered by leaves, sometimes branched. Leaves lanceolate-subulate from a wider, semisheathing base, divergent-spreading and slightly flexuose or falcate (crispate when dry) in the lamina, ± 9 mm. long and 1 mm. wide in the broad base; margin entire below, sharply toothed in the upper lamina, rolled in the upper half of the base but flat above. Costa rather thin, percurrent in the narrow tip. Leaf cells thick-walled, short-rectangular ($\pm 20 \times 10~\mu$) at top lamina, longer and narrower (up to $68 \times 7~\mu$) at base. Perichaetial leaf not differentiated. Seta short, ± 8 mm. long, often curved, lateral by subsequent growth of stem, flexuose when dry, not exserting the capsule out of the leaves. Capsule rounded to pear-shaped, light brown, ± 2 mm. high and 2 mm. in diameter, deeply furrowed when dry. Operculum conical. Peristome deep inserted, outer teeth brownish red, lanceolate, $\pm 570~\mu$ high and 95 μ wide at base, fine papillose; inner teeth alternate, $\pm 460~\mu$ high, hyaline, fine papillose. Exothecial cells thick-walled, upper two rows transversely elliptical but flat, lower cells rounded to angular. Spores large, rounded, 15 to 19 μ in diameter. Synoicous or autoicous.

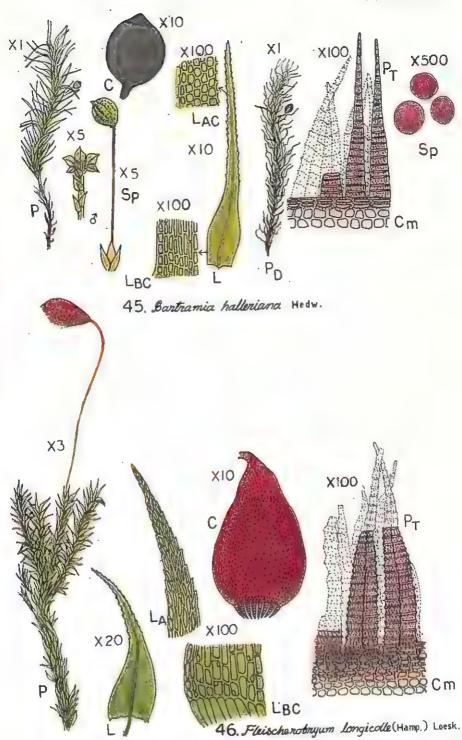
Distribution: Western Himalaya (Kashmir to Kumaon), Sikkim, Darjeeling, Bhutan, Arunachal, Naga Hills, Taiwan, China (Yunnan etc.), Siberia, Japan, New Guinea, Tasmania, New Zealand, Caucasus, North & Central Europe, Great Britain, Central Africa, Hawaii, North & South America. A cosmopolitan species.

DIPLOLEPIDEAE: EUBRYALES: BARTARMIACEAE: FLEISCHEROBRYUM

46. Fleischerobryum longicolle (Hamp.) Loesk.

Plants robust, in loose tufts, yellowish green. Stem erect, reddish, up to 3 cm. high with a whorl of subfloral branches, well-covered by leaves, tomentose and radiculose below. Leaves lax, erect-spreading both moist and dry (contorted when dry), ovate-lanceolate, acuminate-subulate, ± 2.4 mm. long and 0.6 mm. wide at the broader base; margin. \pm flat, entire below, dentate at top. Costa thin, percurrent in the subula. Leaf cells more or less lax; moderately thick-walled; narrowly ovate-rhomboid, $\pm 57 \times 7~\mu$ at top, becoming wider, longer, rectangular ($\pm 76 \times 26~\mu$) and distinctly papillose (single papilla, not centrally placed) at base. Seta apical, erect, long ($\pm 2.8~{\rm cm.}$), reddish, \pm arcuate at tip. Capsule horizontal, elongated pyriform, $\pm 5~{\rm mm.}$ long and 3 mm. in diameter, with a tapering, distinct apophysis and a small mouth. Peristome regular as in Bartramia but endostome of the same height as exostome.

Distribution: Western Himalaya (Garhwal), East Nepal, Darjeeling, Sikkim, Naga Hills, Java, Philippines, Taiwan, China (Yunnan), Japan. A South & East Asiatic species.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: EUBRYALES: BARTRAMIACEAE: BARTRAMIDULA

47. Bartramidula bartarmioides (Griff.) Wijk, & Marg.

Formerly known as *Philonotis griffithiana*. Plants comparatively small and slender, caespitose, green. Stem slender, ± 5 mm. long, with 4 or 5 subfloral innovations of about same length in a ring, thickly covered by leaves, tomentose below. Leaves erect, variable in size, linear lanceolate, acuminate, ± 2.5 mm. long and 0.2 mm. broad; margin strongly inrolled throughout, dentate at tip; costa usually ending in a long excurrent tip (± 0.2 mm.). Leaves on branches smaller ($\pm 1 \times 0.15$ mm.). Leaf cells thin-walled, narrow elongated ($\pm 38 \times 7~\mu$), mamillose at tip; becoming rectangular ($\pm 26 \times 11~\mu$), mamillose at base. Seta apical, erect, slender, ± 1.4 cm. high. Capsule erect, ovoid-subglobose, $\pm 2 \times 1$ mm., wrinkled but not furrowed when dry. Peristome single, only with exostome teeth which are lanceolate, $\pm 190~\mu$ high and $30~\mu$ wide at base. Exothecial cells thick-walled.

Distribution: Sıkkim, Darjeeling, Asşam, Khasia, Naga Hills, Chhotanagpur, Orissa, Midnapur, Western Himalaya (Kumaon, Dehradun, Mussoorie) Western Ghats, Burma, Java, Philippines,

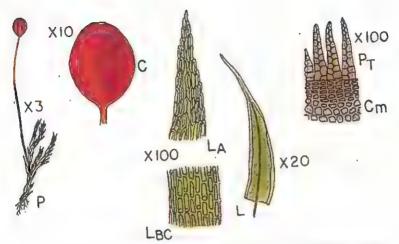
Taiwan, Japan. An Indo-Pacific species.

DIPLOLEPIDEAE: EUBRYALES: TIMMIACEAE: TIMMIA

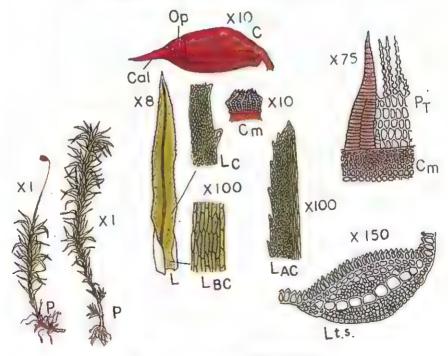
48. Timmia megapolitana Hedw.

Robust, yellow-green (brown below) plants of Polytrichaceae habit forming loose tufts. Shoots erect or inclined, usually unbranched, up to 6.5 cm, long, with rusty rhizoids at radiculose base. Leaves gradually shorter towards base, spreading from an erect, sheathing base, narrow lanceolate above the wider base, up to 10.5 mm. long, ± 1.3 mm. wide at the base and ± 0.95 mm. wide at midlamina, carinate, stiff, folded and curled when dry, sharply apiculate; margin serrate from tip to the top of the base. Costa strong, percurrent, reddish; t.s. shows a row of deuter cells between two wide stereide patches, ventral cells mamillose. Lear base cells smooth, thin-walled, rectangular, yellowish, up to $66 \times 9~\mu$. Lamina cells thick-walled, mamillose on top, rounded-hexagonal, 9 to 10 μ wide. Marginal spine cells larger, tip spine cell largest (±40×26 μ). Seta apical, erect but bent at tip, purplish, ±2 cm high, flexuose when dry. Capsule horizontal or inclined, brownish, elongated oval with short, tapering apophysis and wide mouth, $\pm 2.5 \times 1.28$ mm. Calyptra cucullate, covering whole of the capsule. Operculum convex-apiculate, ±0.58 mm, high, Exothecial cells thick-walled, quadrate above, irregularly rectangular below. Stomata present on apophysis. Outer peristome teeth $\pm 600\,\mu$ high and 120 μ wide at base; basal membrane high (about half the height of exostome), cilia of endostome knotted filamentous, reaches the height of exostome or slightly shorter. Spores 12 to 14 µ in diameter, fine papillose.

Distribution: Bhutan (2-3000 m.), Kashmir, China, Japan, Siberia, Central & West Europe, North America. A North Hemisphere species.



47. Bartramidula bartramioides (Griff.) Wijk. & Marg.



48. Timmia megapolitana Hedw.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES: ORTHOTRICHACEAE: ZYGODON

49. Zygodon obtusifolius Hook.

Reddish plants in dense tufts or cushions. Stems dichotomously branched several times, erect, less than a cm. high. Leaves very small ($\pm 0.7 \times 0.224$ mm.), erectopatent (crisp and appressed to stem when dry) lingulate, distinct from other species of the genus by a rounded tip, Margin \pm flat and entire (except the papilli). Costa strong, ending below tip. Leaf cells incrassate (more so on top), rounded to rounded-quadrate, papillose, $\pm 11~\mu$ wide in most of the leaf; at extreme base the cells are smooth (except for a few papilli on the leaf margin), elongated rectangular near vein leaves not differentiated. Seta erect, apical, ± 3.2 mm. high. Vaginula cylindrical, ± 0.6 mm. high. Capsule red-brown, erect, elongated pyriform, ± 1.36 mm. long including a narrower apophysis (less than a quarter of the length) and ± 0.45 mm. in diameter; 8-striate when dry. Operculum Peristome present, double.

Distribution. East Nepal, Darjeeling, Ceylon, Central Africa, Mexico, all over Andes, Brazil, Australia, New Zealand. A very widespread species.

DIPLOLEPIDEAE: ISOBRYALES. ORTHOTRICHACEAE MACROMITRIUM

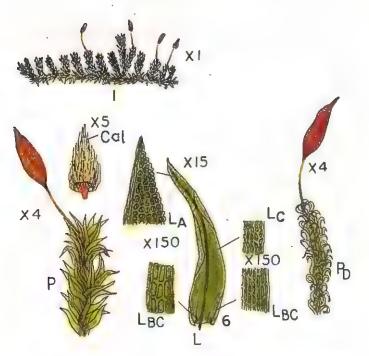
50 Macromitrium moorcroftii (Hook, & Grev.) Schwaegr

Robust, green to brown plants in dense tufts on tree trunks and bamboos. Main stem creeping, 4 cm or more long, giving rise to erect, secondary shoots, ± 1 cm. (may be more) high. Leaves more or less dense, erectopatent, much curled when dry, lanceolate, plicate at base, ± 3.5 mm long and 0.64 mm, wide at base; apex acute-pointed. Margin may be a little revolute at places, otherwise flat, entire except heavy bulging of upper marginal cells. Costa reaching the apex of the leaf with a pointed end. Leaf cells thick-walled, papillose; upper cells rounded-quadrate, ± 11.5 μ wide, highly bulging mamillose with one or more smaller papilli, midleaf cells elongated, papillose, $\pm 15 \times 9\mu$, basal cells with highly thickened walls and elongated linear lumens ($\pm 27 \times 3.8\mu$), about two rows of marginal cells seem to form a border with even narrower and more elongated cells, ner and smooth walls. Seta apical, erect on the lateral shoots, ± 6.2 mm, high. Capsule erect, ± 0.6 mm, high. Exostome dicranate, papillose. Endostome missing. Spores $\pm 27~\mu$ in drameter, spherical. Calyptra mitriform, highly hairy, covering almost the whole capsule.

Distribution: East Nepal, Sikkim, Darjeeling, Khasia, Western Himalaya (Kumaon), Coorg, Burma,



49. Zygodon obtusifolius Hook.



50. Macromitrium mooncroftii (Hook. & Grev.) Schwaegr.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES. CLIMACIACEAE CLIMACIUM

51. Climacium emericanum Brid. ssp. japonicum (Lindb.) Perss.

Robust, glossy, olive-green to brownish, beautiful plants in swampy, wet places. Aerial shoot dendroid, growing from underground or surface-growing, creeping stems. Branch shoots 3 cm. or more nigh. Secondary shoots branching pinnately and the tertiary branches are sometimes quite long. Leaves on main stems larger (±1 92 mm, × 1.1 mm, at base), almost triangular, concave blunt-tipped, with auricles, plicate, costa ending below tip. Branch leaves dense, erect to slightly inclined (more appressed to stem when dry), lanceolate, ±1.6 mm. long and 0.64 mm. wide at base, plicate, acute-tipped; margin plane at top, may be recurved at base, dentate above; costa strong, ending below apex. Most leaf cells elongated rhomboid, $\pm 42 \times 8 \,\mu$, thin-walled. Some larger cells ($\pm 30.8 \times 11.5 \,\mu$) on apical border form marginal spines. Cells at leaf base also similar, may be a little elongated. Alar cells in the auricles rectangular, $\pm 27 \times 8 \,\mu$. Stem attachment cells at extreme base deep brown. Sporophyte not seen.

Distribution. North Bengal Terai (Buxa Dooars), Eastern Tibet, China (Shensi), Japan, East In-

dies. An East Asiatic subspecies.

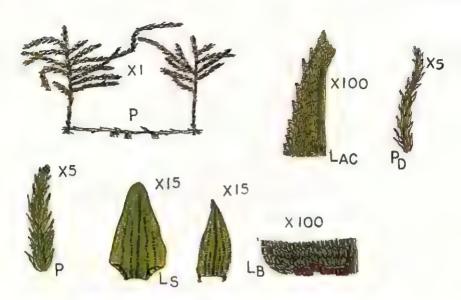
DIPLOLEPIDEAE ISOBRYALES, TRACHYPODACEAE: TRACHYPODOPSIS

52. Trachypodopsis serrulata (P. Beauv.) Fleisch,

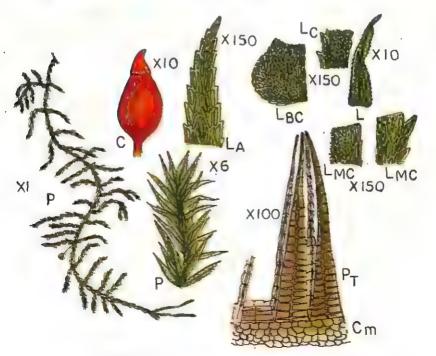
Robust to semirobust plants with reddish tinge, in dense mats. Secondary stems ascending or hanging, up to 10 cm. or even more long, laxly, pinnately branched. Leaves not so dense, erectspreading (slightly curved, flexuose and strongly appressed to stem when dry), plicate, lanceolate, acuminate; margin serrulate, flat, ± 3 mm. long and 0.52 mm. wide at base, base showing faintly developed auricles. Costa ending below apex. Leaf cells thick-walled, rhomboid to elliptical to linear, \pm 38 \times 8 $\mu_{\rm s}$ smooth at leaf apex, lower down about two rows of similar cells form a border; inside cells are rhombold with a single papilla at lumen centre, $\pm 19 \times 8~\mu$; at base juxtacostal cells are broader rectangular (\pm 19 5 \times 7 μ) with porose walls, outer cells are narrower (\pm 19.5 \times 4 μ). A group of quadrate-rhomboid (11.5 \times 7 μ) cells with highly thickened walls are present in the alar region. Sporophyte hanging on the branches of the hanging shoots. Perichaetial Jeaves shorter. Seta about 4 mm. long, rough. Capsule straight, oval, $\pm 1.92 \times 13$ mm. with a short apophysis. Operculum conic-rostrate, ± 0.83 mm. long, beak usually bent to one side. Peristome double and regular

Distribution East Nepal, Sikkim, Darjeeling, Bhutan, Arunachal, Khasia, Naga Hills, Manipur, Andaman is , Western Himalaya, Palni, Ceylon, Burma, Thailand, Sumatra, Indochina, Indonesia, Philippines, Taiwan, China (Yunnan etc.), Mauritius, Madagascar, Central Africa, South Africa,

Mexico, Guatemaia Widespread in Asia, Africa and Central America.



51. Climacium americanum Brid. SSP. japonicum (Lindb.) Perss.



52. Trachypodopsis serrulata (P. Beauv.) Fleisch.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES: PTEROBRYACEAE: TRACHYLOMA

53. Trachyloma indicum Mitt.

Robust, frondose, glossy, yellowish-green plants in loose tufts. Primary stem horizontal, thick, rhizomatous, not very long. Secondary stems erect, rigid, 10 cm. or even more high, pinnately or bipinnately branched above, frondose. Leaves on branches squarrose-spreading, gradually larger upwards on main branches; on secondary branches smaller and often complanate; ovate acuminate, up to 3.85×1.55 mm. on main stem and $\pm 2.37 \times 0.96$ mm. on secondary branches, more or less flat. At base, there are some much smaller, ovate-lanceolate cataphylls (paraphyllia). Leaf margin plane, dentate above. Costa absent, sometimes a very weak, short one may be made out with difficulty. Leaf cells thick-walled, smooth, linear-rhomboid, $\pm 54 \times 8\,\mu$. At base there are a number of shorter, wider, rectangular cells showing porose walls at the middle of each half of the leaf and at leaf attachment. Sporophyte on short side shoots. Perichaetial leaves narrower. Seta erect, ± 1.4 cm. long. Capsule erect, cylindrical, $\pm 5 \times 1.25$ mm. Peristome ± 1 mm. high. Exostome of narrow, lanceclate teeth. Endostome of narrower, papillose segments on a low basal membrane. Calyptra small, split on one side, with small, unicellular hairs. Spores small.

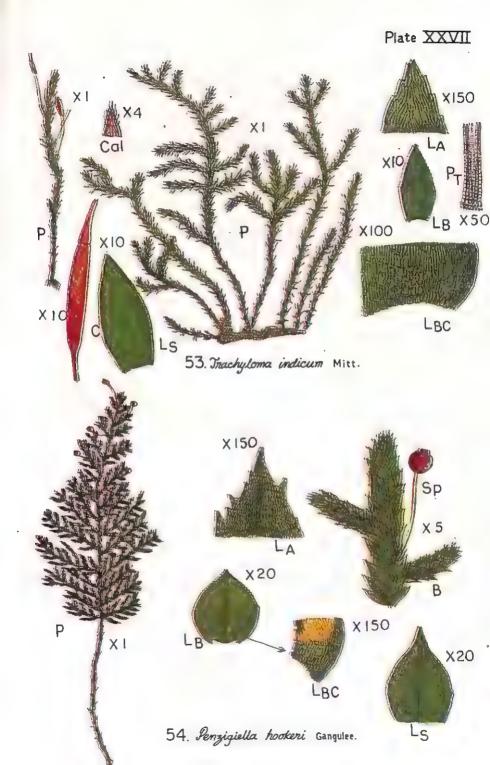
Distribution: Darjeeling, Ceylon, Thailand, Vietnam, Sumatra, Java, Borneo, New Guinea Taiwan, Bismark Is. An Indo-Pacific species.

DIPLOLEPIDEAE: ISOBRYALES: PTEROBRYACEAE: PENZIGIELLA

54. Penzigiella hookeri Gangulee

Main stem rhizomatous. Secondary stem erect, \pm 12 cm high, beautifully frondose, branched regularly tripinnately in one plane, green. Main branch stem leaves (L_S in plate) larger, ovate-cordate, very lax. Branch leaves dense, erect-spreading, concave, cordate, \pm 1.25 × 1 mm., acuminate, margin serfate except at base. Costa single, ending just below tip. Leaf cells thick-walled, elongate-rhomboid to linear, \pm 19.25 × 8 μ at top, longer and narrower (up to 30.8 × 6 μ) lower down. Alar cells differentiated (not always coloured) into rectangular cells up to 19.25 × 11.5 μ . Capsule on short lateral shoots. Perichaetial leaves larger, erect. Seta with a brown vaginula, \pm erect, \pm 3.5 mm. high. Capsule erect, almost globular, \pm 1.26 × 1.15 mm. Peristome normal, double.

Distribution: Darjeeling (about 2250 m.). Endemic in this area,



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES: PTEROBRYACEAE: PTEROBRYOPSIS

55. Pterobryopsis divergens (Mitt.) Nog.

Secondary branches stiff, ascending to hanging, up to 15 cm. long, pinnately branched, with many flagelliform side branches. Leaves dense, squarrose, ovate-subcordate, ±3×1.8 mm., acuminate (tip not cucullate), margin mildly to sharply dentate at tip. Costa single, covering only half the leaf. Leaf cells thick-walled, porose, narrow elongate, $\pm 57 \times 6 \,\mu$ from top to base; cells at leaf attachment red-brown; alar cells distinct in being rectangular to quadrate, up to $10\,\mu$ broad, tinted. Sporophyte on short, lateral shoot. Seta erect, ± 4 mm. long. Capsule erect, oblong-ovate, $\pm\,1.5\, imes0.8$ mm. Peristome double, outer teeth lanceolate, $\,\pm\,0.3$ mm. high; endostome much reduced with short, filamentous segments. Operculum conic-rostrate.

Distribution: East Nepal, Sikkım, Darjeeling, Jaıntıa, Manipur, Burma, Thailand. A Southeast

Asiatic Mainland species.

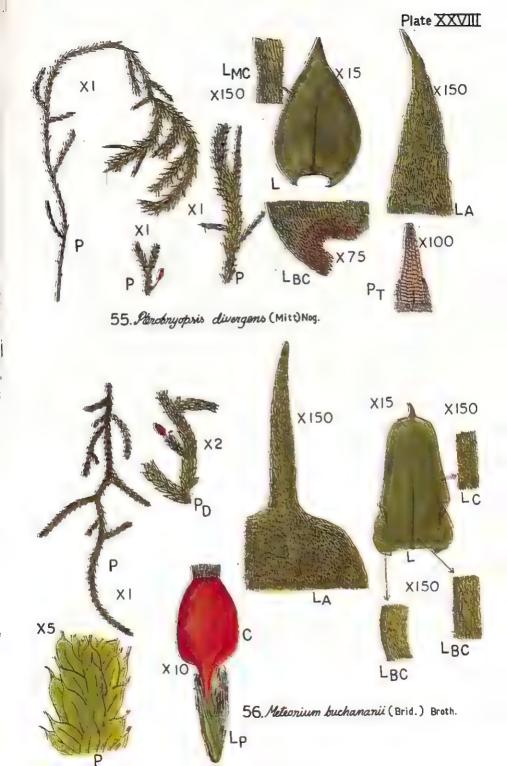
DIPLOLEPIDEAE: ISOBRYALES: METEORIACEAE: METEORIUM

56. Meteorium buchananii (Brid.) Broth.

Secondary branches hanging from trees, pinnately branched, golden green at tips, brown below, 10 cm. or more long. Leaves dense, imbricate, erect, concave, plicate, oblong-ovate, ±3.1 mm. long and 1.66 mm. wide at the auriculate base; tip rounded, suddenly narrowed down into a more or less long subula; margin minutely crenulate and undulate. Costa single, covering two-thirds of leaf. Leaf cells incrassate, unipapillate (smooth in the subula, at extreme base and in the border row), linear elongate to narrow rhomboidal in the subula ($\pm 30 \times 4 \mu$), more distinctly rhomboid $(\pm 20 \times 7 \,\mu)$ in top lamina, again gradually narrowing down below $(\pm 27 \times 5 \,\mu$ in auricle), basal juxtacostal cells are narrowly rectangular with highly porose walls (up to $50 \times 10~\mu$). Sporophytes on short, lateral shoots. Perichaetial leaves very dense with numerous long paraphyses topping them. Seta smooth or slightly rough, short (3 mm. or less long) but completely exserting the capsule. Capsule ovoid, $\pm 2.9 \times 1.58$ mm. Operculum conic-rostrate, may be bent to one side. Calyptra cucullate, hairy. Peristome double; exostome teeth lanceolate, showing clefts along the middle line; endostome segments narrow linear from a low basal membrane, may also show a median line, usually shorter than exostome, both fine papillose.

Some of the characters in this species show variations

Distribution: East Nepal, Sikkim, Darjeeling, Bhutan, Khasia, Naga Hills, Manipur, Western Hımalaya (Garhwal, Kumaon), Nılgiri, Palni, Ceylon, Vietnam, Yunnan. A Southeast Asiatic Maınland species.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES: METEORIACEAE: BARBELLA

57. Barbella stevensii (Ren. & Card.) Fleisch.

Yellowish to dark green, robust plants creeping on tree branches, form clusters with pendulous, long (15 cm. or more long), flexuose, irregularly pinnately branched secondary shoots often with flagellate tips. Leaves squarrose, cordate-lanceolate, $\pm 2.8 \times 1$ mm., smaller near tips, apex narrow acuminate, base cordate, margin denticulate almost to base. Costa single, covering two-thirds of leaf. Leaf cells linear elliptical with 1 to 3 papilli except at tip and base, $\pm 77 \times 6~\mu$ at tip and at lamina, basal cells smooth, shorter and wider ($\pm 60 \times 11~\mu$); alar distinct with wide rectangular (up to $57 \times 20~\mu$), deep brown, smooth cells having porose walls. Sporophyte on small side shoots. Seta straight, $\pm 2~\text{mm}$ long, fully exserting the capsule. Capsule erect, ovate, $\pm 1.4~\text{mm}$ long and 0.7 mm. in diameter. Peristome double, $\pm 130~\mu$ high. Operculum conic-rostrate, tip usually slightly bent. Calyptra subcucultate, smooth.

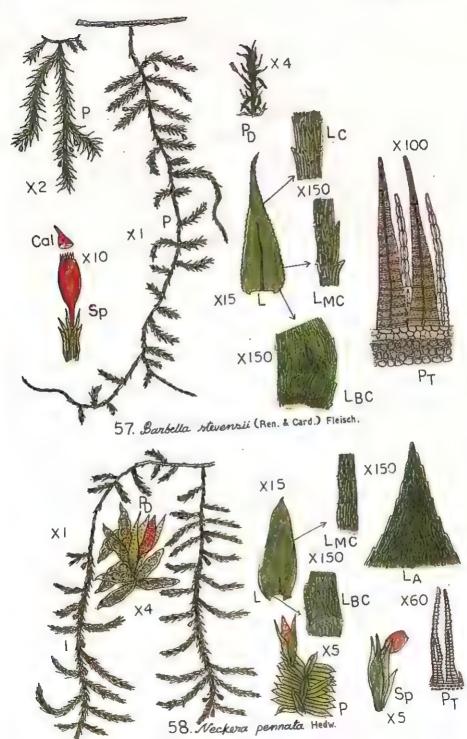
Distribution: East Nepal, Sikkim, Darjeeling, Arunachal, Khasia, Naga Hills, Burma. An Indo-Burmese species.

DIPLOLEPIDEAE: ISOBRYALES: NECKERACEAE: NECKERA

58. Neckera pennata Hedw.

Robust plants with creeping, wiry main stem and yellow-green (brownish at base), usually pendent, irregularly pinnate, about 10 cm. long secondary branches. Leaves complanate, asymmetrical, incurved on one side, cultriform, horizontally spreading, transversely undulate when dry, ovate-lanceolate, narrowing down at tip into a short acumen, ± 2.1 mm. long and 0.77 mm. wide; margin faintly crenulate at tip. Costa single, very short. Leaf cells elongate linear, incrassate with highly porose walls, $\pm 46 \times 8~\mu$ at top, narrower and less porose ($\pm 57 \times 6~\mu$) in lamina, again wider and more porose near base; alar cells not coloured but irregularly quadrate-rectangular ($\pm 30 \times 11~\mu$). Sporophyte on small lateral shoots on main secondary branches. Perichaetial leaves long, sheathing, narrow acuminate. Seta short, not exserting capsule but capsule gets partly exserted when mature. Capsule ovoid-oblong, $\pm 2 \times 1$ mm. Operculum conic-rostrate. Exostome teeth irregularly divided; endostome very much reduced.

Distribution: North Bengal Dooars, Bhutan, Assam, Simla, Kashmir, Palni, Vietnam, S.E. Tibet, Yunnan, Japan, Amur basın, Europe, North & Central Africa, North America, Andes, Australia New Zealand. A cosmopolitan species.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: ISOBRYALES: NECKERACEAE: THAMNOBRYUM

59. Thamnobryum fruticosum (Mitt.) Gangulee

Very robust, dendroid plants, yellowish green above, brownish below. Main stem rhizomatous, densely tomentose, propagating by runners. Secondary branches in clusters, dendroid, pinnately branched, erect, up to 20 cm. high, stipes with distantly placed, small, appressed, scaly leaves. Leaves in about four rows, sometimes showing complanate tendency, ovate-lanceolate, mostly asymmetrical, up to 2.94×1.47 mm. on main branches; margin serrulate at tip, smooth below, showing a tendency to be inflexed on one side at base. Leaves longitudinally undulate when dry. Costa strong, covering more than three-fourths of leaf. Leaf cells incrassate, smooth, irregularly rhomboid-elongate ($\pm 30 \times 9~\mu$), often full of gleaming chloroplastids at tip, rhomboid elongate ($\pm 57 \times 11.5~\mu$) with highly porose walls at midleaf; elongated rectangular ($\pm 70 \times 11.5~\mu$) also with highly porose walls at extreme base. Sporophytes (often in large numbers) develop on small lateral shoots in the uppermost branches. Perichaetial bud small (± 1.6 mm. high), leaves narrow, erect with spreading tips. Seta erect or slightly curved, ± 2.3 cm. high. Capsule mostly slightly nodding, ovate, $\pm 2.5 \times 1.1$ mm. Peristome ± 0.6 mm. high, double, normal neckeroid. Spores globose, fine papillose, 12 to 15 μ in diameter.

Distribution: East Nepal, Sikkim, Darjeeling, Arunachal, Ceylon, Taiwan. An Indo-Pacific species.

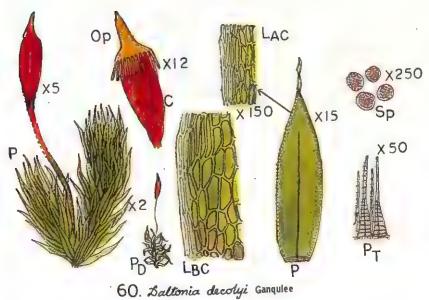
DIPLOLEPIDEAE: HOOKERIALES: HOOKERIACEAE: DALTONIA

60 Daltonia decolyi Gangulee

Plants small labout 6 mm. long in fertile shoots and about 1 cm. in sterile shoots), yellow-green, often growing in clusters. Leaves erect (flexuose on top when dry), carinate below, oblong-lanceolate, \pm 4.16 \times 1.15 mm , margin strongly bordered, apex acute tortuose. Costa single, covering more than two-thirds of leaf. Leaf cells firm but not thick-walled, irregularly rhomboid, \pm 50 \times 10 μ at apex; irregularly rectangular, \pm 69 \times 23 μ at base becoming gradually longer and narrower (up to $100\times12\,\mu$) towards margin and shorter, coloured at extreme base along stem attachment. A thick border of cartilaginous cells (about 4 rows, becoming thinner at extreme apex and extreme base), \pm 77 \times 7 μ , completely surround the leaf. Sporophyte on lateral shoots. Seta erect or winding, \pm 9 mm. long, scabrous on tip. Capsule erect, ovate, \pm 2.1 \times 0.64 mm. Operculum conic-rostrate, \pm 0.7 mm. high. Calyptra mitriform, fimbriated at base, covering only the tip of the capsule Peristome double, normal. Spores 19 to 23 μ in diameter, fine papillose.

Distribution Darjeeling (Kurseong and nearabouts). Endemic in this locality.





BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HOOKERIALES: HOOKERIACEAE: DISTICHOPHYLLUM

61. Distichophyllum griffithii (Mitt.) Par.

Monoicous. Plants yellow-green, lax, often epiphyllous. Stems simple or branched, erect or ascending, often more than 1 cm. long. Leaves dense on upper stem, erect to erectopatent (more appressed to stem when dry), complanate, ovate-lanceolate, $\pm 2.56 \times 1$ mm.; apex narrow pointed; margin bordered, strongly wavy both when wet or dry, recurved at places, entire. Costa single, covering about $\frac{3}{2}$ of leaf. Leaf cells at apex small, irregularly quadrate-hexagonal, thick-walled, $\pm 11 \times 9~\mu$; lower down lax, subrectangular, thin-walled, $\pm 60 \times 23~\mu$ becoming narrow elongated at border; margin of about 2 rows of very narrow, elongated, cartilaginous cells completely covering leaf. Sporophytes on short, lateral shoots. Perichaetial leaves smaller. Seta usually sinuose, $\pm 7.5~\text{mm}$. long. Capsule nodding, pyriform to obovate, small, $\pm 0.7 \times 0.3~\text{mm}$. Operculum conicrostrate. Calyptra campanulate, fimbriate at base. Peristome double, normal.

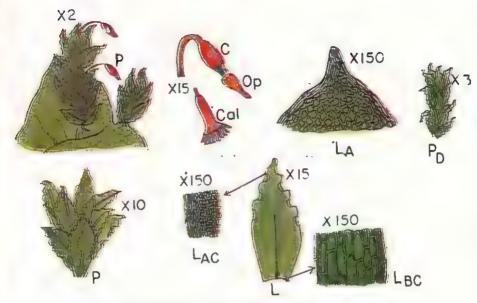
Distribution: East Nepal, Arunachal, Khasia. Endemic in this area.

DIPLOLEPIDEAE: HOOKERIALES: HOOKERIACEAE: HOOKERIA

62. Hookeria acutifolia Hook, & Grev.

Robust, yellow-green to bright green, glossy plants forming scattered tufts with procumbent or erect shoots and erect, complanate, wide branches. Stem with central strand. Leaves pentastichous, close set, spreading (scaly, loose, and slightly crumpled when dry), ovate-acute, up to 6.5×3 mm.; tip acute, very often showing tufts of rhizoids (probably because of the very moist condition in which these plants grow); margin flat and entire. Costa absent. Leaf cells thin-walled, rhomboid, poor in chloroplastids (probably because of the shade favoured by these plants), $\pm 105 \times 45$ μ at tip, $\pm 300 \times 75$ μ at base in the inner region (shorter towards margin); one marginal row of more or less rectangular ($\pm 150 \times 45$ μ) cells completely border the leaf. Sporophyte on short lateral shoot. Perichaetial leaves few, small. Seta straight or flexuose, arcuate at tip, ± 2 cm. long. Capsule horizontal, $\pm 2.6 \times 1.1$ mm., ovate from a narrower apophysis. Exothecial cells collenchymatous. Operculum conic-rostrate. Calyptra conical, mitriform, ± 1.1 mm. long, only faintly lobed at base. Peristome double. Exostome teeth oval in cross-section, lanceolate; endostome segments hyaline, lanceolate on a high basal membrane. Spores greenish, small, fine papillose, 10 to 13 μ in diameter.

Distribution: East Nepal Sikkim, Darjeeling, Arunachal, Khasia, Palni, Ceylon, Vietnam, Java & Indonesian Islands, Pacific Islands, Szechuan, Korea, Japan, Riukiu, Taiwan, Eastern Australia, Southern U.S.A., Mexico, Guadeloupe, Ecuador, West Indies, Bolivia, Brazil. A Pantropical species.



61. Distiehophyllum griffithii (Mitt.) Par.



. 62. Hooperia acutifolia Hook. & Grev.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE. ISOBRYALES: HYPOPTERYGIACEAE: CYATHOPHORELLA

63. Cyathophorella adiantum (Griff.) Fleisch,

Main stem rhizomatous, tomentose, short creeping. Secondary branches erect, loosely tufted, usually unbranched, sometimes forked near tip, often caudate at tips, up to 6 cm. tall and 1 cm. wide with leaves; clusters of filamentous, orange-red gemmae may be present near top. Leaves iax, widely spreading (shrunk but still widely spreading when dry), lateral leaves may be a little asymmetrical, oblong-ovate, acuminate, ± 4.8 mm. long (reported up to 6 mm.) and 1.9 mm. broad; margin serrate-spinose, the spinose cells form a border; at base where spines are not present, one to three rows of elongated ($\pm 120 \times 15\,\mu$), pallid cells form a border in its place. Amphigastrial leaves in one row, symmetrical, ovate-acuminate, $\pm 2.7 \times 1.4$ mm. Costa forked, short. Traces of two very short costas also traceable on amphigastrial leaves which have a similar areolation. Leaf cells rhomboid, $\pm 75 \times 20\,\mu$ at top with spine cells up to $105\,\mu$ long; longer, irregularly rhomboid ($\pm 125 \times 30\,\mu$), pitted at base. Lateral perichaetial shoots many on stem. Perichaetial leaves narrow, much smaller. Sata shert, lateral, ± 2 mm. long, just exserting the capsule. Capsule oblong-cylindrical, $\pm 2.58 \times 1.1\,\mu$ mm. Operculum conic curvi-rostrate, $\pm 0.6\,\mu$ m, high. Peristome normal neckeroid. Spores papillose, big, $\pm 30\,\mu$ in diameter.

Distribution: East Nepal, Sikkim, Darjeeling, Bhutan, Khasia, Lusai, Western Himalaya, Philippines. An Indo-Pacific species.

DIPLOLEPIDEAE. ISOBRYALES: HYPOPTERYGIACEAE DENDROCYATHOPHORUM

64. Dendrocyathophorum paradoxum (Broth.) Dix.

Main stern rhizomatous, tomehtose. Secondary branches dendroid, pinnate, sometimes a number of branches fasciculated together. Leaves similar to Cyathophorella. Lateral leaves horizontal to slightly raised (shrunk with tips often bent down when dry), asymmetrically ovate-lanceolate, $\pm 3 \times 1.2$ mm, apex narrow apiculate, margin dentate in upper half of leaf, bordered only at base. Costa single, short, not more than half leaf length. Leaf cells thin-walled with porose walls (specially from midleaf to base), elongated rhomboid ($\pm 96 \times 12~\mu$), at base two rows of narrow elongated cells form a spineless border. Amphigastrial leaves in one row, may be alternately bent right and left, symmetrical, ovate apiculate (apiculus narrow and often very long), up to 1.6×0.6 mm., costa and areolation similar to lateral leaves. Sporophyte on small lateral shoots. Penchaetial leaves smaller, narrower, erect. Seta more or less erect, 6 to 8 mm. long, often bent and sometimes rough at tip. Capsule horizontal to erect, cylindrical, $\pm 1.3 \times 0.64$ mm., sometimes larger. Peristome double, $\pm 360~\mu$ high, exostome teeth dark brown, lanceolate ($\pm 70~\mu$ wide at base), close striped, with a vertical zigzag line, endostome segments of same height, narrower, transparent, papillose, short cilia reported.

Distribution Darjeeling, Arunachal, Thailand, Vietnam, Philippines, Taiwan, Japan. An East Asiatic species.



64. Lendrocyathophorum paradoxum (Broth.) Dix.

BRYIDAE: ARTHRODONTEAF DIPLOLEPIDEAE: ISOBRYALES: HYPOPTERYGIACEAE: HYPOPTERYGIUM

65. Hypopterygium flavolimbatum C. Muell.

Yellow-green, semirobust plants. Main stem creeping, densely tomentose. Secondary branches erect, frondose or dendroid with sparsely leaved stipe, usually about 4 cm high, regularly or irregularly pinnately branched. Lateral leaves wide-spread, asymmetrical, ovate-lanceolate, $\pm\,1.4\! imes\!0.77$ mm., apex acute apiculate, margin bordered throughout, almost entire. Costa single, long, ending a little behind tip in lateral leaves and exserted in an arista in amphigastrial leaves. Amphigastrial leaves symmetrical, rounded ovate, aristate, ± 0.88 mm. long with the arista and 0.6 mm. wide, in one row. Leaf cells rhomboid to hexagonal, $\pm 27 \times 13 \mu (\pm 38 \times 13 \mu \text{ in the jux-}$ tacostal basal region). About two rows of elongated linear (\pm 115 \times 13 μ), hyaline cells form a clear border of the whole leaf and also of amphigastrial leaves. Sporophytes on short lateral shoots in the upper regions. Perichaetial leaves narrow, erect. Seta narrow, erect, bent at top (sometimes arcuate), up to 1.8 cm. long. Capsule ovate-cylindrical, variable in length, 1.3 to 2.37×1 mm. Peristome normal double, ± 0.45 mm. high, exothecium and endothecium of same height, there is one short cilia between each two endothecial segments.

Distribution: Western Himalaya (Garhwal, Dehradun, Mussoorie, Jaunsar), East Nepal,

Arunachal, Khasia. Endemic in the Himalayas.

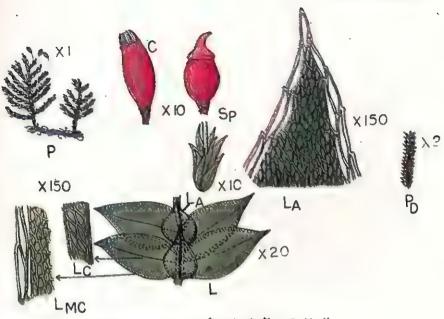
DIPLOLEPIDEAE: HYPNOBRYALES: LESKEACEAE: REGMATODON

66. Regmatodon declinatus (Hook.) Brid.

Plants in loose tufts, light green to dark green. Main stem creeping giving rise to erect branches which, usually, again branch pinnately and are not more than 1.5 cm. tall, julaceous, Leaves dense, imbricate, erectopatent (erect and appressed to stem when dry), concave, ovate-apiculate, apiculus short, $\pm 1.53 \times 0.64$ mm., margin entire. Costa single, covering a little more than half the leaf length. Leaf cells irregularly elliptical-rectangular-hexagonal, incrassate, $\pm 19 \times 7 \,\mu$ at tip, becoming rectangular in the border rows; at base cells are more incrassate and elongated (up to 31×6 μ lumen at the juxtacostal region), becoming shorter towards margin (\pm 19 \times 6 μ) with the border rows of shorter, more rectangular cells (\pm 10 \times 6 μ), a few cells at extreme base (near stem attachment) wider. Seta from lateral perichaetial shoots, erect, rough (specially at tip) ± 1 cm. high. Capsule erect, ovate-cylindrical, $\pm 2.24 \times 0.96$ mm. Peristome double, inserted deep below urn mouth. Exostome teeth dark brown, with thick transverse lamelli, $\pm 300\,\mu$ long of which half is below urn mouth level. Endostome much higher than exostome, with a very low basal membrane, segments pale lanceolate, partially split along median fissure, $\pm 550\,\mu$ high. Spores brown, rounded, coarse papillose, 25 to 27 μ in diameter.

Distribution: East Nepal, Khasia, Burma, S.W. China, Taiwan. An India-Burma-China-Taiwan species.

Plate XXXIII



65. Hypopterygium flavolimbatium C. Muell



66. Legnatodon declinatus (Hook.) Brid.

7.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: LESKEACEAE: LESCURAEA

67. Lescuraea incurvata (Hedw.) Lawt,

Plants of moderate size in dense interwoven mats, yellow-green at tops, green to brownish below. Main stem creeping, branches erect to prostrate, pinnate. Leaves dense, erectopatent (appressed when dry), concave, plicate, ovate-lanceolate apiculate. Stem leaf larger, up to 2×1 mm. Branch leaf $\pm 0.9\times 0.34$ mm., may be secund; margin revolute in the middle of the leaf, smooth. Costa single, strong, ending well below apex in stem leaves but very near apex in branch leaves. Leaf cells irregularly hexagonal-rhomboid, $\pm 15\times 7\,\mu$ at apex; basal juxtacostal cells as on top, becoming wider ($\pm 16\times 9\,\mu$) towards margin but 3 or 4 marginal rows are quadrate to rectangular. Perichaetial leaves longer (up to 3 mm.), clasping, sporophytes on side shoots. Seta erect, long (± 2.3 cm.), smooth. Capsule inclined to horizontal, curved at gibbous apophysis, constricted below mouth when dry, ovate-oblong, $\pm 2.25\times 0.9$ mm. Peristome double, $\pm 400\,\mu$ high. Exostome teath lanceolate, united below urn level. Endostome with high basal membrane, segments keeled, perforated along keel, of same height as exostome. Cilia rudimentary. Spores small ($\pm 12\,\mu$ in diameter), fine papillose.

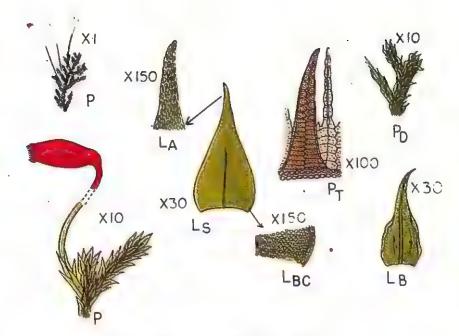
Distribution: East Nepal, Kashmir, Murree, Afghanistan, North & Central Asia, Japan, Europe (including Caucasus to Great Britain), North Africa, Greenland, North America. Cosmopolitan in the North Hemisphere.

DIPLOLEPIDEAE: HYPNOBRYALES: THUIDIACEAE: CLAOPODIUM

68. Claopodium assurgens (Sull. & Lesq.) Card.

Phyllodioicous. Female plants robust, yellow- to dirty-green, not glossy. Main stem long, creeping (mostly epiphytic), with distant, erect, dendroid branches which may be several centimetres high. Stem leaves larger, up to 1.5×0.7 mm., widest at base, cordate-lanceolate, ending in a narrow margin revolute, finely crenulate. Costa single, strong, almost reaching tip. Leaf cells rounded to hexagonal, moderately incrassate, $\pm 7~\mu$ wide, papillose usually with one papilla on top of lumen; also smooth and elongated (up to $27~\mu$) and smooth; similarly juxtacostal basal cells are long, erect, papillose. Capsule cylindrical, mostly nodding. Calyptra narrow, cucullate, smooth. Peristome normal, double; basal membrane low; endostome segments as long as exostome, naron leaves of female plants.

Distribution: Nainital, Arunachal (Abor), Nilgiri, Java, Taiwan, Japan, China (Yunnan, Kweichow). A South & East Asiatic species,



67. Lescuraea incurvata (Hedw.)Lawt.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: THUIDIACEAE: ABIETINELLA

69. Abietinella abietina (Hedw.) Fleisch.

Dioicous. Robust plants in extensive yellow-green mats. Stems ascending, branching dichotomously, up to 10 cm. long Branches once-pinnate only. Stem leaves large, lanceolate-acuminate from a very wide, ovate base, plicate, margin recurved, $\pm 2.4 \times 0.9$ mm, at base. Branch leaves dense, erectopatent (appressed to stem and imbricate when dry), ovate-acuminate, plicate, $\pm 1.2 \times 0.5$ mm, at midleaf, margin crenulate-dentate. Costa strong, ending below tip, rough on back. Leaf cells incrassate, ovate-hexagonal-rhomboid, with one high papilla on each side of lumen, $\pm 15 \times 11~\mu$ all over the leaf. Paraphyllia numerous on all branches, mostly branched. Setae long from side shoots. Capsule cylindrical, curved. Peristome double, well-developed but cilia lacking. Calyptra cucullate. Spores fine papillose.

Distribution: Kashmir, Gilgit, Jammu, Chamba, East Nepal, Darjeeling, Bhutan, Central Asia, Siberia, Amur Manchuria, Japan, Caucasus, Europe (incl. G.B.), Alaska, Greenland, Virginia to British Columbia, Colorado, A North Hemisphere species.

DIPLOLEPIDEAE: HYPNOBRYALES: THUIDIACEAE. THUIDIUM

70. Thuidium cymbifolium (Doz. & Molk.) Doz. & Molk.

Dioicous. Large, yellow-green to deep green (may be brownish when old) plants forming dense mats. Main stem creeping, arched or ascending, may spread to 15 cm. (reported up to 40 cm.), with central strand, giving off regularly or irregularly bi- or tripinnate branches. Paraphyllia dense on stems, usually branched lanceolate, may be fillform. Stem leaves erectopatent, ovate-triangular, ending in a long arista formed by the excurrent costa, plicate, up to 3 (with arista) x 1 mm. Branch leaves erectopatent (erect when dry), concave, ovate-lanceolate with acute apex, up to 0.5 mm. long on secondary stem and 0.3 mm. long on ultimate branches, margin irregularly crenulate (sometimes entire). Costa ending below apex. Leaf cells more or less rhomboid, $\pm 11 \times 8 \,\mu$, with single papilli on both sides of lumen. At extreme base, cells (except at margin) elongated, $\pm 19 \times 9$ μ , smooth. At the region of attachment there are some broad, lax cells, $\pm 30 \times 19 \mu$. Sporophytes on main stems. Perichaetial leaves oblong-lanceolate, up to 3 x 1 mm., costa extended into a long flexuose arista and the margin on the upper half also showing a number of long, stender, flexuose cilia. Seta erect but arcuate at top, up to 5 cm. long, smooth. Capsule inclined to drooping, ovatecylindrical, somewhat asymmetrical, ±3 2 × 1.5 mm. Operculum conic-rostrate, ±1,28 mm. long Peristome normal hypnoid, ±0.8 mm. high, exostome-endostome of same height, cilia shorter than endostome, nodose, usually in groups of three but may be even more. Calyptra cucullate, smooth. Spores small (7-10 μ), smooth (larger and papillose also reported).

Distribution. A beautiful moss extending all over the Indian temperate Hills (All over the Himalayas including Manipur & Naga Hills; Nilgiris, Palni, Ghats, Nicobar Is, Ceylon), Burma, Malay, Thailand, Sumatra, Indonesia, Taiwan, China, Korea, Japan, Australia, Oceania. Extensive in South & East Asia to Australia.





BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: THUIDIACEAE: ACTINOTHUIDIUM

71. Actinothuidium hookeri (Mitt.), Broth.

Dioicous Very robust, pale green to darker plants growing in dense tufts usually in dripping water in association with Sphagnum which it simulates in general habit. Main stem creeping or ascending, 10 cm. or more long, with regular, dense, once-pinnate branches which are up to 1.4 cm. long and become quickly narrowed down at tips. All stems covered by numerous branched, lanceolate paraphyllia. Stem leaves moderately lax, spreading, plicate, ovate-lanceolate, up to 2×1.4 mm. Branch leaves dense, erectopatent (closely appressed to stem and imbricate when dry), plicate, ovate-lanceolate, generally with acute apex, 1.2 × 0.55 mm or shorter, margin regularly dentate, may or may not be incurved at places. Costa ends below apex. Leaf cells elongated rhomboid ($\pm 31 \times 7 \mu$, slightly larger in marginal dentate row) with somewhat wavy and thick walls, the tip of each cell in the upper leaf raised like a papilla, otherwise smooth. Midleaf cells of same size but with thinner walls. Basal cells as on top but two rows away from border there are 2 or 3 rows of shorter, diagonally elongated, rhomboid-hexagonal, pellucid cells, \pm 15 \times 7 μ . At leaf attachment there are some wide, finted cells, $\pm 30 \times 19 \,\mu$. Sporophyte not common, but develop on main stems. Seta erect or bent, 4 cm or more long. Capsule bent or horizontal, curved, ovate-cylindrical. Peristome normal as in Thuidium. Exostome-endostome of same height, basal membrane high, cilia nodose, in groups of three, shorter than endostome segments. Operculum conical, shortly apiculate.

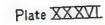
Distribution: East Nepal, Sikkim, Darjeeling, Bhutan, Naga Hills, Burma, Yunnan, Shechuan, Taiwan, Soviet Far East. An East Asiatic species.

DIPLOLEPIDEAE HYPNOBRYALES AMBLYSTEGIACEAE DREPANOCLADUS

72. Drepanocladus uncinatus (Hedw.) Warnst.

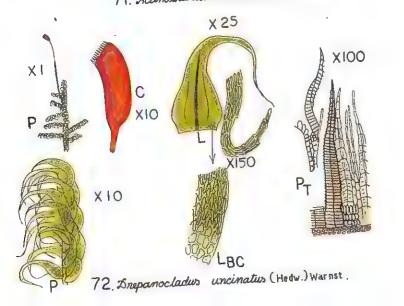
Autoicous. Light green to golden green (not reddish) plants in wide mats, variable from slender to robust. Stems prostrate to suberect, regularly or irregularly distant pinnate branched. Leaves dense, strongly faicato-secund, ovate-lanceolate with a long, narrow tip which is often nooked or circinate, plicate, concave, up to 2 cm. long and 0.64 mm. wide. Costa strong, disappearing at base of the long-tip. Leaf cells incrassate, linear (\pm 38 × 6 μ) at tip, smooth, at base cells are wider with porose walls, \pm 31 × 8 μ , at extreme, somewhat decurrent base, cells look somewhat nificated at the alar regions, \pm 23 × 15 μ , also with porose walls. Sporophytes on main branches Perichaetial leaves longer, narrower foblong fanceolate, erect. Seta long (\pm 2.2 cm.), erect, curved at tip. Capsule inclined to horizontal, ovate cylindrical, curved, \pm 2.5 × 1 mm. Peristome nor mal, hyphoid, exostome teeth bordered, basal membrane high, cilia 2, annulus of 3 rows present.

Distribution Afghanistan, Swat, Baltistan, Kashmir, Kangra, Lahul, Garhwal, East Nepal, Sikkim, Bhutan, Caucasus, Central Asia, Siberia to Amur, Kamchatka, Sakhalin, Japan, China, Europe linci G B) Greenland, Labrador, Alaska, Canada, U S A , Central & South America, North Central South Africa, Asutralia, New Zealand, Antarctical A cosmopolitan species





71. Actinothuidium hookers (Mitt.) Broth.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: AMBLYSTEGIACEAE: CALLIERGONELLA

73. Calliergonella cuspidata (Hedw.) Loesk.

Dioicous. Yellow-green, glossy plants in dense tufts. Main stem ascending to erect, up to 16 cm. long, rigid, pinnately branched. Stems and branches cuspidate at tops by convolute leaves. Outer layer of stem cells large, thin-walled and hyaline. Stem leaves loosely imbricate to erect open, ovate-oblong, narrowed but sometimes obtuse at the tip, concave, with two short veins (sometimes ecostate), alar differentiated, $\pm 1.75 \times 0.85$ mm. Branch leaves smaller but similar, spreading or erectopatent below (all appressed erect with raised tips when dry), usually ecostate, margin smooth, involute at base on both sides, $\pm 1.2 \times 0.38$ mm. Leaf cells at apex linear, somewhat vermiculate, moderately incrassate. $\pm 53 \times 8~\mu$; rectangular at base; alar differentiated by short and wide rectangular cells $\pm 30~\mu$ wide, pale. Indian specimens sterile but sporophytes develop on main stems in foreign specimens. Seta long (4 to 7 cm.), erect, arcuate. Capsule horizontal, curved, subcylindrical, 3.5-4.5 \times 1-1.6 mm. Operculum conic-apiculate. Peristome and annulus normal hypnoid with cilia in groups of three.

Distribution: East Nepal, Darjeeling, Bhutan, Caucasus, Syria, Western & Eastern Siberia, Japan, New Guinea, Europe (Incl. G.B.), Azores, North Africa, Canada, Northern U.S., West Indies, Argentina, Australia, New Zealand. A cosmopolitan species.

DIPLOLEPIDEAE: HYPNOBRYALES: BRACHYTHECIACEAE: HOMALOTHECIUM

74. Homalothecium nilgheriense (Mont.) Robins.

Robust, yellow-green to golden green plants forming tufts. Main stem creeping, giving rise to erect branches which are again much branched in an irregular, once pinnate manner (branched shoots 3 cm. or more high). Leaves dense, in several rows, erect-spreading (erect when dry), ovate-lanceolate, plicate, $\pm 3.4 \times 1$ mm., broadly cordate at base, narrowly acuminate at tip; margin reflexed at insertion, plain above, dentate at tip. Costa strong, single, covering ½ to two-thirds of leaf length. Leaf cells linear, smooth, up to $50~\mu$ long; alar differentiated with quadrate-rectangular cells which are paler but more thick-walled (up to $38 \times 9~\mu$). Sporophytes on main branches. Seta erect or curved, $\pm 1.5~\mathrm{cm}$. long, smooth. Perichaetial leaves erect, more subulate. Capsule erect, ovate-cylindrical, Spores 14 to $18~\mu$ in diameter.

Distribution: Mussoorie, Garhwal, East Nepal, Khasia, Nilgiri, Palni, Ceylon, Java, Philippines, China, Madagascar. An Indian-Pacific Ocean species.



(Mont.) Robins.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES, BRACHYTHECIUM

75. Brachythecium rutabulum (Hedw.) B.S.G.

Autoicous. Plants of variable habit, more or less robust, glossy, bright to yellowish green (dark below), in dense tufts. Main stem creeping, long, branches irregular pinnate, erect or ascending, rather thick. Leaves terete, spreading (almost squarrose), appressed and somewhat imbricate but still with outspread tips when dry, concave, plicate, cordate-lanceolate with narrow acumen, margin more or less denticulate to very near base, $\pm 3.2 \times 1.2$ mm. on stem and $\pm 2.1 \times 0.7$ mm. on mature branches. Costa covering ½ to two-thirds of leaf length. Leaf cells irregularly linear or narrow rhomboidal, $\pm 77 \times 8\,\mu$ at tip, $\pm 58 \times 11.5\,\mu$ at base, at extreme base cells are lax, oval-hexagonal, $\pm 27 \times 5\,4\,\mu$, scarcely larger at alar. Sporophytes on main branches. Perichaetial leaves oblong, nerveless, with long and narrow acumen. Seta erect, arcuate, long (more than 2 cm.), rough all over. Capsule ovate-oblong, horizontal. Operculum conical short rostrate. Peristome perfect hypnoid.

Distribution: Kashmir, Jammu, Chamba, Garhwal, N.W.F.P., East Nepal, Sikkim, Afghanistan, Central Asia, Caucasus, Tibet, Amur, Japan, Taiwan, Europe (Incl. G.B.), Madeira, South Africa, Greenland, Canada & U.S. (south to Missouri, not known in West coast), Australia. A cosmopolitan

species.

DIPLOLEPIDEAE. HYPNOBRYALES: BRACHYTHECIACEAE: EURHYNCHIUM

76. Eurhynchium praelongum (Hedw.) B.S.G.

Dioccus. Bright or dull yellow-green plants in straggling tufts. Main stem creeping, slender, rather long Branches pinnate or bipinnate, erect or ascending. Leaves differing in size in primary and secondary branches, lax, erectopatent to spreading (shrunk but not much changed when dry in primary branches but erect and appressed in younger branches), cordate-lanceolate (almost triangular) with a long, slender apiculus, decurrent at base, $\pm 1.1\times0.5~{\rm mm}$, margin dentate to base. Single costa covering about % of leaf. Leaf cells elongated, narrowly rhomboid, $\pm 53\times8$ μ , cells at extreme base lax, rectangular, $\pm 38\times11.5~\mu$, somewhat different at alar. Sporophytes on main shoot. Perichaetial leaves erect-squarrose. Seta erect, $\pm 1.9~{\rm cm}$ long, scabrous all along length. Capsule horizontal, ovate-cylindrical, $\pm 1.28\times0.77~{\rm mm}$. Operculum large, conic long rostrate, as long as urn. Peristome perfect.

Distribution. Western Himalaya, Sikkim, Darjeeling, Kurdistan, Caucasus, Siberia, Japan, Europe (inc. G.B.), St. Helena, Azores, Algeria, U.S. A., Mexico, Australia, New Zealand. A cosmopolitan species.



76 Eurhynchium praelongum (Hedw.) B.S.G.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: ENTODONTACEAE: PLEUROZIUM

77 Pleurozium schreberi (Brid.) Mitt.

Dioicous. Robust, yellow-green, glossy plants forming tufts. Stems red, more or less erect, pinnately branched, rigid. Leaves dense, imbricate, somewhat puffed up, erectopatent (appressed to stem when dry), strongly concave and boat-shaped so that it becomes plicate when pressed down, ovate-oblong, apex blunt with margin incurved, contracted and slightly decurrent at base, faintly dentate at tip. Costa double, short. Leaf cells incrassate, often with porose walls, linear, $\pm 34.6 \times 8\,\mu$ at top (a few cells at extreme tip very short), $\pm 65 \times 11.5\,\mu$ below. Alar cells at base deep red brown, $\pm 38.5 \times 15\,\mu$ to quadrate, becoming narrower and longer along margin on top. Sporophytes on the main erect stems. Seta erect, $\pm 3.3\,\mathrm{cm}$. long, red-brown, smooth. Capsule horizontal, oblong-cylindrical, $\pm 2.56 \times 1.2\,\mathrm{mm}$. Peristome deep-inserted, normal hypnoid; exostome $\pm 0.8\,\mathrm{mm}$. high, teeth $\pm 0.12\,\mathrm{mm}$. wide at base; endostome segments pale, sometimes shorter than exostome; nodose cilia present in groups of two or three. Spores 14 to 18 μ in grameter.

Distribution: East Nepal, Sikkim, Bhutan, Yunnan, Turkestan, Siberia, Japan, Canada, northern United States, Central & South America, Europe (incl. G.B. and Arctic). A widespread

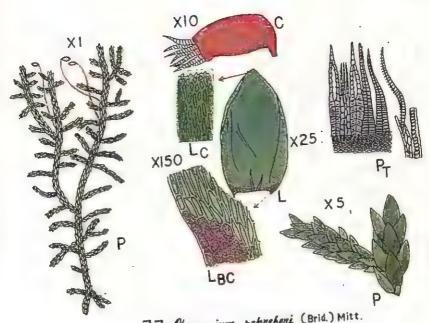
temperate-alpine species.

DIPLOLEPIDEAE: HYPNOBRYALES: ENTODONTACEAE: TRACHYPHYLLUM

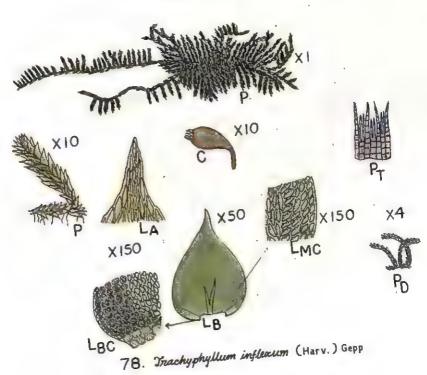
78. Trachyphyllum inflexum (Harv.) Gepp.

Diorcous. Comparatively slender, yellow-green, dull plants forming extensive, thin mats. Main stem long, irregularly branched, creeping, giving rise to short, erect or ascending (curved when dry), julaceous branches. Branch leaves dense, patent to spreading (imbricate and appressed to stem when dry), concave, cordate-ovate, abruptly short-apiculate, small ($\pm 0.675 \times 0.45$ mm.), margin almost smooth. Costa short, forked. Leaf cells elongated rhomboid ($\pm 31 \times 5~\mu$), papillose at tip and lamina (excluding border); median cells at base ovate-rectangular and smooth with the basal angle cells transversely elongated and chlorophyllose, $\pm 11.5~\mu$ wide; at extreme base angle, on the auricular part, there are a few larger quadrate cells ($\pm 14~\mu$ square) which are chlorophyllose but smoother. Sporophytes very rare but capsule known to be oval ± 1 mm. long on thin, erect, arcuate, ± 1.5 cm. long seta which is yellowish red and smooth; peristome normal double, endostome basal membrane high, cilia 2.

Distribution: East Nepal, Sikkim, Darjeeling, Orissa (all epiphytes), Bangladesh, Central India, Kanara, Burma, Thailand, Cambodia, Vietnam, Java, Moluccas, Philippines, China, Australia, New Caledonia, Madagascar. A tropical-subtropical Indo-Pacific species.



77. Ileurozium schreberi (Brid.) Mitt.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: ENTODONTACEAE: ENTODON

79. Entodon rubicundus (Mitt.) Jaeg.

Dioicous. Yellow-green to golden green (sometimes with reddish tinge), glossy plants in extensive and dense mats. Stem extensively creeping and branching (may cover a large area, a large piece of rock or dead wood). Stem leaves wide ovate, shortly apiculate, $\pm 1.7 \times 1$ mm. Branch leaves smaller, dense erectopatent all round stem (appressed when dry), concave, ovate-lanceolate, contracted at base, margin mildly crenulate at top. Costa usually absent but sometimes weak, short, double veins are seen. Leaf cells elongated rhomboid, $\pm 46 \times 7~\mu$, slightly shorter at extreme tip; basal angle cells lax, quadrate ($\pm 19 \times 19~\mu$) to irregular rectangular. Sporophytes abundant on main stems. Perichaetial leaves erect-spreading with narrower tips. Seta erect, red-brown, up to 2.5 cm. long. Capsule cylindrical, erect, sometimes curved. $\pm 4.48 \times 0.77$ mm. Operculum conic, long rostrate, ± 1.6 mm. long. Calyptra cucullate, covering only the tip of the capsule but coming down more than half of it. The columella, with the spores attached to it, often gets loose and projects out of the peristome. Peristome double, normal, very long, exostome-endostome of same height. Spores very fine papillose, 11.6 to 15 μ in diameter.

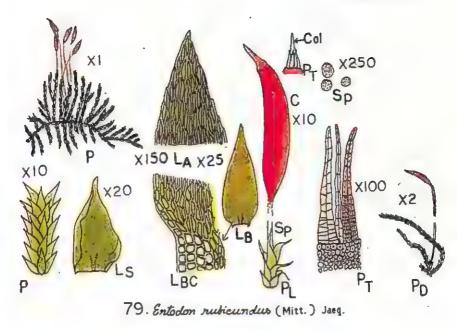
Distribution: Western Himalaya, East Nepal, Sikkim, Darjeeling (very common), Bhutan, Assam, Khasia, Andaman, South Indian Hills, Yunnan, Korea, Eastern Siberia, Japan, Philippines.

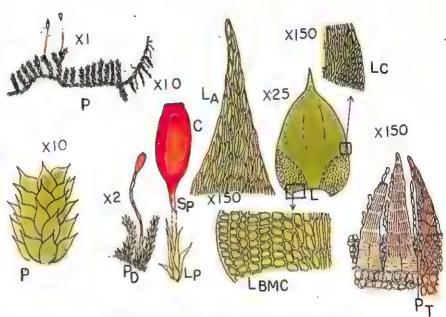
DIPLOLEPIDEAE: HYPNOBRYALES: ENTODONTACEAE: ERYTHRODONTIUM

80. Erythrodontium julaceum (Schwaegr.) Par.

Robust, rigid, glossy, golden green to brown plants in dense tufts. Mostly epiphytic. Main stem creeping, 8 cm. or more long, with narrow central strand. Branches numerous, short, julaceous, erect. Leaves dense, terete, imbricate, erectopatent (appressed to stem with outspread tips when dry), concave, ovate, $\pm 1.6 \times 0.8$ mm., with suddenly narrowed, short tips, margin smooth (there may be faint denticulations at tip), flat. Ecostate. Leaf cells smooth, narrow elliptical to linear, $\pm 57 \times 7$ transverse, ovate-rectangular cells reaching to considerable heights on two margins measuring up to 23 \times 15 μ . Sporophytes on main stem or very strong branches. Perichaetium small, of erect, Capsule erect, ovate-cylindrical, red, $\pm 2.75 \times 1$ mm. Operculum conical, short rostrate. Calyptra ostome teeth red, 16, broadly lanceolate with horizontal stripes at base and vertical stripes above; endostome ill developed, formed of 16 short, very fragile segments which are almost adhering to the inner side of the exostome teeth. Spores coarse papillose, large (20 to 30 μ in diameter)

Distribution. Mussoorie, Kumaon, East Nepal, Sikkim, Darjeeling, Bhutan, Assam, Khasia, Orissa Hills, Ni.giri, Coorg, Palni, Ceylon, Burma (Moulmein), Thailand, Laos, Tonkin, Sumatra, Java, Celebes, Philippines, Yunnan, Central & South Africa, Solomon Islands. A widespread palaeotropical





80. Enythrodontium julaceum (Schwaegr.) Par.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: PLAGIOTHECIACEAE. PLAGIOTHECIUM

81. Plagiothecium neckeroideum B.S.G.

Dioicous. Robust, yellow-green, glossy plants in lax mats. Main stern creeping, central strand, absent, branch shoots erect, or curved, irregularly pinnately branched, branches \pm complanate. Leaves erectopatent (erect and appressed when dry), concave, ovate-lanceolate, narrowed at base which is \pm decurrent, asymmetrical in the lateral rows, $\pm 3.46 \times 1.29$ mm., apex acute, margin faintly crenulate at top. Costa short, double, with two unequal forks the longer of which is more than $\frac{1}{2}$ leaf length. Leaf cells linear, narrow rhomboid, $\pm 68 \times 8 \,\mu$ at top (with a few very small cells at extreme tip) becoming slightly wider lower down; at basal angles there are several rows of quadrate to rectangular ($\pm 30 \times 19 \,\mu$) cells which often fill up the entire extreme leaf base. Sporophytes on main branches. Perichaetial leaves narrow, erect. Seta reddish, erect or spreading, smooth, ± 2.4 cm long. Capsule horizontal, ovate or oblong-cylindrical, $\pm 1.6 \times 0.7$ mm. Operculum conic long rostrate, ± 1.1 mm long. Peristome normal hypnoid, double with 2 to 3 cilia. Spores 12 to 15 μ in diameter. Leaves sometimes show filamentous, multicellular gemmae at tips. Leaf tips often transversely undulate.

Distribution: Western Himalaya, East Nepal, Sikkim, Darjeeling, Bhutan, Palni, Sumatra, Java, Borneo, New Guinea, Philippines, Taiwan, China, Japan, Eastern Siberia, Europe (Alps etc.). Eastern Asia & Europe.

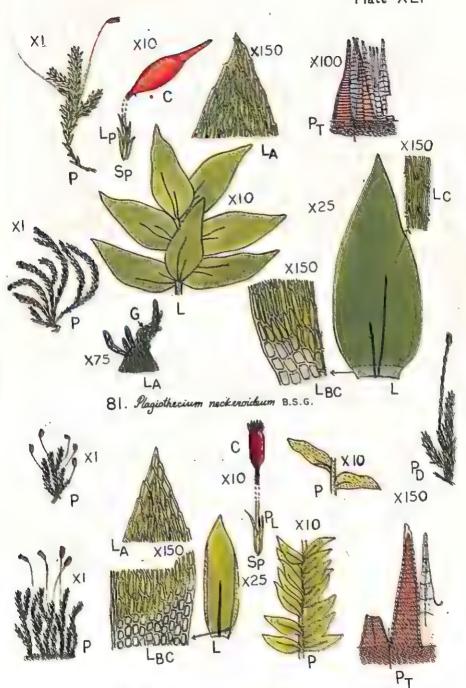
DIPLOLEPIDEAE: HYPNOBRYALES: PLAGIOTHECIACEAE: STEREOPHYLLUM

82. Stereophyllum wightii (Mitt.) Jaeq.

Monoicous Somewhat slender, glossy (sometimes silky iridescent), yellow-green to green, mostly corticolous plants in thin mats. Main stem creeping, irregularly branched, giving rise to erect, irregularly pinnately branched shoots. Leaves in about four rows, complanate, lateral rows better developed and very often asymmetrical with a single costa reaching the midleaf unequally dividing the leaf, oblong-lanceolate, apex acute (the degree of acuteness is variable but the leaf top is narrower than in the allied species anceps), concave, erectopatent (lower leaves on branches sometimes spreading), appressed to stem when dry; margin often inflexed on one side at base, sometimes involute at both margins, slightly dentate at tip; 1.5×0.7 mm.; narrowed at leaf base where it may be slightly decurrent. Leaf cells elongated, elliptical rhombord, $\pm 55 \times 8 \, \mu$ at top, slightly wider at base, basal angle cells differentiated by lax, rectangular cells (23 to 11 5 × 11.5 to 11 μ). These cells often cover the whole of the extreme leaf base. Sporophytes on main branch stems. Perichaetial leaves erect, narrow. Seta slender, reddish smooth, erect, 8 to 11 5 mm. long. Capsule erect to horizontal, ovate-cylindrical, 1.2 to 1.5 × 0.4 mm. Peristome normal, hypnoid, double; exostome teeth $\pm 255 \, \mu$ high, 60 μ broad at base, lanceolate; endostome segments shorter than exostome, basal membrane about $\frac{1}{100}$ 0 of peristome high. Spores round to elliptical

Distribution: Dehradun, Mussoorie, Chhotanagpur hills, Orissa, West Bengal Plains, Assam, Khasia, Madras, Palni, Coorg, Kanara, Western Ghats, Ceylon, Burma, Thailand, Vietnam, Java A tropical South-East Asiatic species

Plate XLI



82. Stereophyllum wightii (Mitt.) Jaeq.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE HYPNOBRYALES: SEMATOPHYLLACEAE, WIJKIA

83. Wijkia tanytricha (Mont.) Crum

Robust, yellow-green (brownish in older parts), glossy, large and spreading plants forming tufts. Main stem creeping, without central strand, much branched, branches pinnate or bipinnate, ultimate branches often curved. Stem leaves lax, larger, oblong-ovate, plicate, narrowed into a long, filliform subula, lamina $\pm 1.4 \times 0.9$ mm., subula ± 0.77 mm. long, usually twisted. Branch leaves dense imbricate, erectopatent (appressed with outspread tips when dry), concave, ovate-lanceolate with tip narrowed into a long subula, lamina $\pm 0.9 \times 0.42$ mm., subula ± 0.45 mm. long, margin dentate at shoulder but smooth at subula and lamina. Ecostate. Leaf-cells narrow linear, $\pm 76 \times 6~\mu$; alar differentiated, extreme cells $\pm 69 \times 31~\mu$, hyaline or tinted, yellowish along point of attachment. Sporophytes on main branches. Seta slender, erect or curved, ± 3 cm. long. Capsule inclined, ovate-cylindrical, $\pm 2.88 \times 0.9$ mm. Operculum conic, long rostrate, ± 1.47 mm. long. Annulus present. Peristome perfect normal with 1 to 2 cilia.

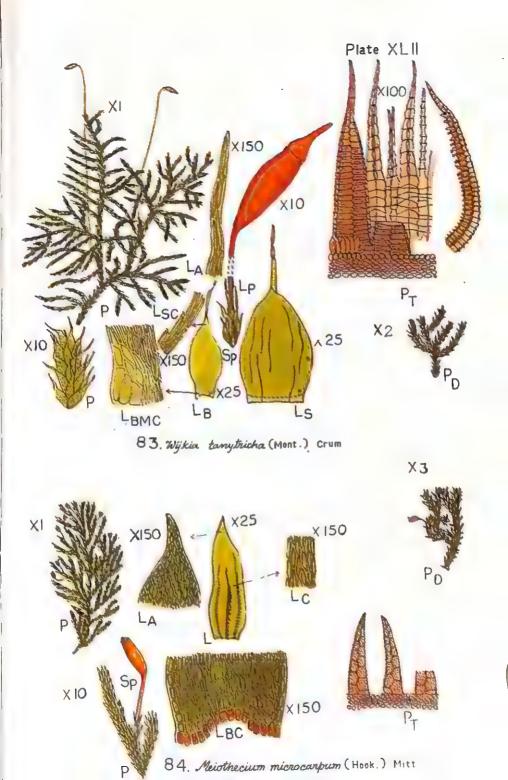
Distribution, Sikkim, Darjeeling, Bhutan, Vietnam, Sumatra, Java. An Indonialesian species

DIPLOLEPIDEAE. HYPNOBRYALES SEMATOPHYLLACEAE: MEIOTHECIUM

84 Meiothecium microcarpum (Hook.) Mitt.

Autoicous Normal to quite big, yellow-green, more or less glossy plants in low tufts. Main stem creeping, often bushy, branches pinnate, without central strand. Leaves dense, erect to erect topatent, concave, plicate (2 to 3 plicae), oblong-ovate, $\pm 1.5 \times 0.5$ mm, apex short-acuminate, margin entire. Ecostate Leaf cells rhomboid, $\pm 36 \times 6\,\mu$ at top, longer below (almost linear). Alai cells large, ovate rectangular, tinted or hyaline, usually extending all along leaf insertion. Sporophytes on main stems. Perichaetial leaves erect, narrower on top. Seta erect, smooth, short (not more than 5 mm.). Capsule inclined or horizontal, ovate-cylindrical, small (± 1.5 mm. long). Operculum conic, long rostrate. Peristome single, exostome teeth. ± 0.3 mm. high, lanceolate, coarsely papillose on both sides, placed rather distantly, median line zigzag, endostome or annulus not developed. Spores 25 to 30 μ in diameter, rough papillose. The taxon has a variable habit.

Distribution East Nepal, Eastern Himalaya, Assam, Ceylon, Singapore, Java to New Guinea, Philippines, Japan, New Caledonia, Samoa South & East Asia to Pacific.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: SEMATOPHYLLACEAE: SEMATOPHYLLUM

85. Sematophyllum subhumile (C. Muell.) Jaeg.

Monoicous. Yellow- to brownish green, glossy, medium-sized plants often forming tufts on tree bases. Main stern creeping, 7 or more cm. long, branching irregularly. Secondary branches pinnate, suberect. Leaves not dense, erectopatent, concave, ovate-lanceolate from ovate base, ±1.3×0.4 mm. (stem leaves larger), margin crenulate at tip, often involute on both sides at midleaf. Ecostate. Leaf cells narrow, elongate rhomboid, $\pm 60 \times 5 \mu$, cell walls irregularly thickened. Alar differentiated, hyaline, cells broadly elliptical to oblong, largest ones $\pm 60 \times 30~\mu$. Sporophytes on main stem or principal branches. Seta erect or curved, slender, ±1 cm. high. Capsule nodding to horizontal, oval, with an apophysis. Operculum long rostrate. Exothecial cells collenchymatous. Calyptra cucullate. Annulus not developed. Peristome normal double. Spores 12 to 15 μ in diameter.

Distribution: East Nepal, Upper Assam, Nilgin, Palni, Burma, Thailand, Java. A Southeast Asiatic

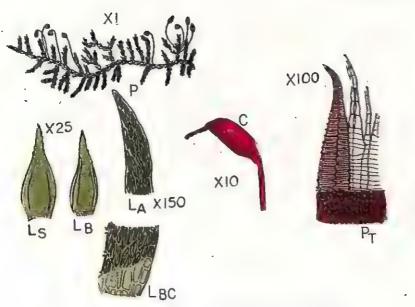
species.

DIPLOLEPIDEAE: HYPNOBRYALES: SEMATOPHYLLACEAE: FOREAUELLA

86. Foreauella orthothecia (Schwaegr.) Dix. & Vard.

Robust, yellowish-, golden- to brownish-green plants in dense, intricate mats. Main stem creeping. giving rise to short, erect branches. In natural semidry or dry conditions, the branches are all curled at tips and the homomallous, falcate leaves present a characteristic appearance rendering the identification of the taxon very easy in the field or the herbarium. Leaves with two very short nerves. Stem leaves appressed, broadly triangular from an obovate base. Branch leaves spreading (homomallous, secund when dry - as stated above), ovate-lanceolate, concave, slightly plicate, acute apiculate at tip, \pm 1.15 \times 0.45 mm., margin faintly crenulate at top. Leaf cells irregularly narrow, elongate rhomboid ($\pm\,46\times5~\mu$), alar distinguished by large, rounded-rectangular, inflated, \pm 20 × 15 μ (largest at angle) cells of which there are 2 or 3 at alar and there is a row along the line of attachment. Sporophytes on main stem. Perichaețial leaves narrow, erect. Seta slender. erect (bent at top), ± 2 cm. long. Capsule horizontal to nodding, ovate-cylindrical, $\pm 2 \times 0.96$ mm. Operculum conical, short rostrate, ± 0.77 mm. long. Peristome normal, $\pm 450\,\mu$ high. Endothecial cells rectangular, not collenchymatous. Spores 21 to 30 μ in diameter, highly papillose.

Distribution. Palni, Orissa Hills, East Nepal. Darjeeling, Assam, Khasia, Thailand, Philippines. Pacific Ocean Islands. An Indo-Pacific species.



85. Sematophyllum subhumile (C. Muell.) Jaeg.



BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: SEMATOPHYLLACEAE. BROTHERELLA

87. Brotherella falcata (Doz. & Molk.) Fleisch.

Phyllodioicous. Large (10 to 20 cm), trailing, yellow-green to reddish, glossy plants, often pendulous. Ultimate branches small, erect to ascending. Leaves spreading (appressed to stem when dry), often falcate, ovate-lanceolate, concave, larger on stem (\pm 1.66 \times 0.6 mm.) than on branch (\pm 1.47 \times 0.48 mm), apex narrowly acute, margin dentate at apex. Ecostate. Leaf cells narrow elongate, \pm 54 \times 6 μ at apex, \pm 60 \times 6 μ at leaf; cells from below apex to median cells at midleaf show papillose development of leaf tips; alar differentiated, about 4 large (\pm 77 \times 38 μ), inflated, oblong cells in one row with a few irregular cells on top; alar tinted yellow or reddish, one or two rows of cells joining alars along line of attachment elongated and porose. Sporophytes on main stems. Perichaetial leaves narrow, erect. Seta slender, erect or flexuose, \pm 1.3 cm. long (known to be up to 2.3 cm.). Capsule ovate to oblong, inclined to horizontal, often arcuate and asymmetrical, \pm 1,86 \times 0.96 mm. Operculum conic, long rostrate. Annulus not developed. Exothecium not collenchymatous. Peristome normal, double, cilia irregular.

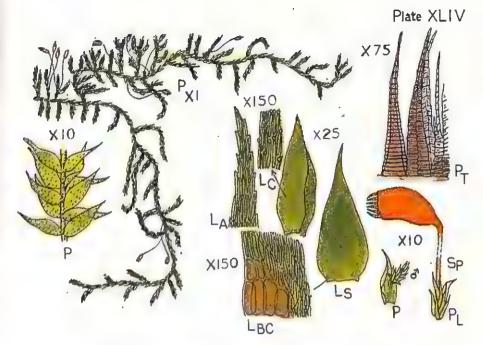
Distribution: Arunachal, Java, Borneo, Celebes, Taiwan. A Southeast Asiatic species.

DIPLOLEPIDEAE. HYPNOBRYALES: SEMATOPHYLLACEAE: TRICHOSTELEUM

88. Trichosteleum hamatum (Doz. & Molk.) Jaeq.

Monoicous. More or less robust, pale green to brownish green, matte glossy plants in dense, intricate mats. Main stems creeping, often epiphytic, irregularly pinnately branched, branches decumbent or ascending. Leaves crowded, often falcato-secund, lanceolate acuminate from a concave, ovate base, often hamate, $\pm 2.5 \times 0.5$ mm., margin sharply dentate at top, sometimes involute here and there in the lower half. Ecostate. Leaf elongated elliptical to rhomboid, $\pm 50 \times 5~\mu$, pluripapillate with one row of papilli on the lumen (except on the border rows and the extreme leaf base). Alar differentiated by about three large, oblong, inflated hyaline cells at the extreme angle. There are some tinted cells at the line of insertion. Sporophytes on main stems. Peridhaetial leaves narrow, erect. Seta slender, erect, mostly arcuate at top, 1 to 1.5 cm. long, coarsely papillose at top, smooth below. Capsule inclined, horizontal or drooping, ovate-cylindrical, small. Operculum long rostrate (as long or longer than urn). Peristome normal, double, basal membrane about $\frac{1}{2}$, cities and the long or longer than urn). Peristome normal, double, basal membrane about $\frac{1}{2}$,

Distribution: Arunachal, Palni, Ceylon, Sumatra, Java, Celebes, New Guinea, Philippines, Japan, New Caledonia, Hawaii. An Indo-Pacific species.



87. Brotherella falcata (Doz & Molk.) Fleisch.



BRYIDEAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: SEMATOPHYLLACEAE: TAXITHELIUM

89. Taxithelium nepalense (Schwaegr.) Broth.

Autoicous. Robust, yellow-green, corticolous (or on bases of tree-trunks), dull to slightly glossy plants forming dense tufts. Main stem long, creeping, irregularly giving rise to erect or ascending branches of equal heights. Branches usually terete, sometimes may be slightly complanate. Leaves dense, erectopatent (appressed to stem when dry), strongly concave, ovate with acute tips, $\pm 1.15 \times 0.45$ mm.; margin faintly denticulate at top, flat. Enervate. Leaf cells spindle-shaped, $\pm 38 \times 6$ μ (a few shorter cells at extreme tip), with one longitudinal row of firm papilli, similar but somewhat larger at base; alar and attachment cells smooth, alar cells large rectangular but not inflated. Sporophytes on main stem. Perichaetial leaves long, narrow, erect. Seta erect or flexuose, ± 1.7 cm. long, smooth. Capsule inclined or horizontal, curved, constricted under mouth when dry, oval, $\pm 1.28 \times 0.5$ mm. Operculum conical, apiculate. Calyptra cucullate. Peristome double, hypnoid, ± 330 μ high, cilia single, basal membrane high. Spores 13 to 18 μ in diameter.

Distribution: East Nepal, Jalpaiguri Dooars, Garo Hills, Calcutta and adjoining districts, Orissa, Assam, Bangladesh, Madras, Karwar, Kanara, Burma, Thailand, Malay, Java, Moluccas, New

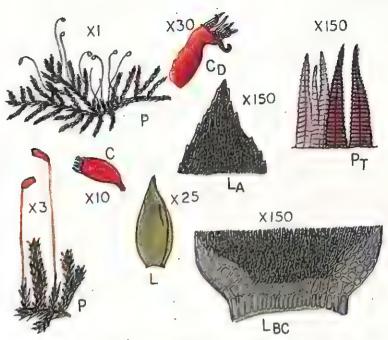
Guinea, Fiji, Samoa, Tasmania, Central Africa. A Palaeotropical species.

DIPLOLEPIDEAE: HYPNOBRYALES. HYPNACEAE: TAXIPHYLLUM

90. Taxiphyllum taxirameum (Mitt.) Fleisch,

Dioicous. Yellow-green to bright green, glossy, medium-sized plants forming extensive but low tufts. Main stems creeping, branching irregularly, strongly complanate. Leaves dense, distichous (except at tip), widely spreading (shrunk but still spreading when dry), concave, ovate-lanceolate, up to 1.5×0.6 mm., mostly short acuminate, margin variably denticulate from tip to near base, flat but may be involute at one side at base. Costa absent but rarely very short, indistinct, double nerves may be distinguished. Leaf cells elongated rhomboid to linear, mostly with papillose cell tips, $\pm 32 \times 7.5~\mu$ at tip, $\pm 72 \times 7~\mu$ at lower leaf, shorter ($\pm 38 \times 7~\mu$) at base with some very short quadrate cells at attachment. Sporophytes on main stems. Seta slender, \pm erect, ± 1 cm. long (but reported to be up to 2 cm.). Capsule horizontal, cylindrical, cernuate, $\pm 1.28 \times 0.45~\text{mm}$. (also fofiar, lanceolate.

Distribution: Mussoorie, Simla, Nainital, Ranikhet, Almora, East Nepal, Darjeeling, Bhutan, Arunachal, Upper Assam, Khasia, Orissa Hills, Bangladesh, Palni, Coorg, Ceylon, Burma, Vietnam, Sumatra, Java, New Guinea, Philippines, Taiwan, Yunnan, Korea, Japan, Siberia, Oceania, Australia. Widespread in Indo-Pacific regions.



89. Taxithelium napalense (Schwaegr.) Broth.



90. Taxiphyllum taxirameum (Mitt.) Fleisch.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: HYPNACEAE: ISOPTERYGIUM

91. Isopterygium bancanum (Lac.) Jaeg.

Autoicous. Antheridial buds near the female, Medium robust, glossy, yellow-green plants in low tufts. Main stem creeping (up to 10 cm. long), pinnately branched. Branches usually simple, complanate, up to 1 cm. long. Leaves dense, spreading (crumpled when dry), concave, ovatelanceolate, narrowly acuminate, $\pm 1.2 \times 0.4$ mm.; margin sharply dentate in upper half. Costa absent (rarely short, double). Leaf cells elongate-rhomboid to linear, thin-walled, 4 to 5 μ wide and up to 75 μ long. Sporophytes on main shoot. Penchaetial leaves entire, erect, long acuminate. Seta erect to sinuose, slender, up to 1.4 cm. long, reddish. Capsule nodding to pendulous, ovatecylindrical. Operculum conic, short rostrate. Calyptra cucullate. Peristome normal double, hypnoid, teeth papillose, single short cilia between segments. Spores 15 to 25 μ , papillose.

Distribution: Bhutan, Vietnam, Banka Is., Java, Philippines. An Indomalesian species.

DIPLOLEPIDEAE: HYPNOBRYALES. HYPNACEAE: HYPNUM

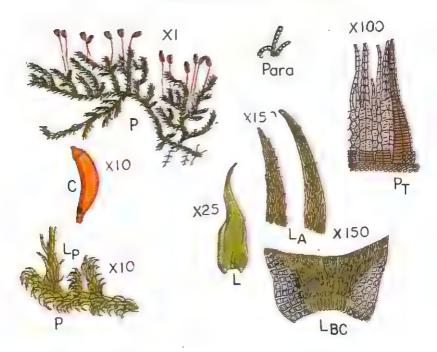
92. Hypnum cupressitorme Hedw.

Dioicous. A rather variable species showing many forms. Mostly robust, light or greyish green, glossy, procumbent plants. Branching irregularly pinnate, branches spreading or ascending, often curved. Paraphyllia very few. Leaves closely imbricate, falcate, concave, ovate- or oblong-lanceolate, margin smooth or faintly denticulate at tip. Costa short double but may be indistinct. Leaf cells linear; alar well-developed by a large number of quadrate to subquadrate cells. Sporophytes on main stems. Top perichaetial leaves erect, sheathing. Seta slender, erect, long (2.5 cm. or more). Capsule erect to nodding, curved, subcylindrical. Operculum conic short rostrate. Penstome perfect,

Distribution: Kashmır, Western Himalaya, Sıkkım, Khasia, Palnı, Central Asia, Caucasus, Siberia, Europe (incl. G.B.), China, Japan, North, Central, South Africa & Madagascar, Canada, U.S.A. Cental & South America, Australia, New Zealand. A cosmopolitan species.



91 Isopterygium bancarum (Lac.) Jaeg



92. Hypnum cupressiforme Hedw.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: HYPNACEAE: ECTROPOTHECIUM

93. Ectropothecium buitenzargii (Bel.) Mitt.

Dioicous. Yellow-green to brownish, glossy, robust plants in extensive mats. Main stem creeping, branching regular pinnate, usually in one plain, blunt at tips. Leaves may or may not be falcate, erectopatent (appressed to stem when dry), concave, ovate-lanceolate, narrow at acute tip, $\pm\,1.3\times0.6$ mm.; margin sharply dentate at tip and less so to a little above base. Costa short double to the cost of the cost ble, sometimes indistinct. Leaf cells elongate, narrow rhomboid, $\pm 54 \times 6~\mu$, usually smooth but sometimes show raised tips near margin at midleaf. Alar distinguished by a row of irregular rectangular, tinted cells (\pm 34 \times 8 μ) at extreme base and some shorter irregular cells above. Perichaetia high, perichaetial leaves erect with raised tips. Sporophytes on main stems. Seta slender, erect wavy, arcuate at tip, long (\pm 3.3 cm.). Capsule horizontal to nodding, cylindrical, \pm 3.2 \times 1.2 mm. including a short apophysis. Operculum conic short rostrate. Peristome normal hypnoid, cilia in groups of three between endostome segments and of same height.

Distribution: Darjeeling, Arunachal, Khasia, Sumatra, Java, Amboina, Celebes, Borneo. An

Indomalesian species.

DIPLOLEPIDEAE: HYPNOBRYALES: HYPNACEAE: VESICULARIA

94. Vesicularia montagnei (Bel.) Broth.

Autoicous. Yellow-green, scarcely glossy plants forming thin but very extensive mats covering large areas. Main branches irregular, spreading widely, secondary branches regularly pinnate, complanate. Leaves erectopatent to spreading (shrunk with curved down tips when dry), ovate, concave, $\pm 1.4 \times 0.7$ mm., apex abruptly acute acuminate, denticulate at tip. Costa short double, mostly indistinct. Leaf cells lax, rhomboid to hexagonal, $\pm 65 \times 20~\mu$ at top, $\pm 77 \times 20~\mu$ at lower leaf, smooth, chlorophyllose; alar not differentiated, only extreme basal cells shorter. Sporophytes on main branches. Perichaetial leaves narrow on top, upper erect, lower spreading. Seta slender, erect or slightly bent, arcuate at apex, 1.5 to 2 cm. long. Capsule pendulous, gibbous at base, ovate-cylindrical, $\pm\,1.34\times0.58$ mm. Peristome normal hypnoid with two cilia shorter than endostome segments.

Distribution. Western Himalaya, Arunachal, Lower Bengal (grows and fruits luxuriantly on the floors of different plant nurseries in Calcutta and outside), Bangladesh (Cox's Bazar), South India, Ceylon, Thailand, Sumatra, Java, Borneo, Philippines, China, Australia, Oceania, South & East





BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: HYPNACEAE: PTILIUM

95. Ptilium crista-castrensis (Hedw.) De Not.

Dioicous Robust, yellow-green, silky plants in loose tufts. Stem rigid, erect or ascending, with a central strand of small, thick-walled cells, branching regular pinnate in one plane. Leaves strongly falcatosecund, mostly hooked at tip in branch leaves, appressed to stem when dry, oblonglanceolate (\pm 1 92 × 0.65 mm), plicate in stem leaves, smaller (\pm 1.15 × 0.32 mm.), ovate-lanceolate branch leaves, gradually narrowed at top into a long acumen which is usually hooked in the branch leaves; margin dentate in upper leaf. Costa short double. Leaf cells linear rhomboid, \pm 39 × 5 μ at top, \pm 77.5 × 5 μ in the lower half. Alar differentiated by a group of irregular rectangular cells up to 23 × 12 μ . Sporophytes on main stems or branches. Perichaetial leaves narrow, clasping, erect. Seta slender, erect, \pm 3.7 cm. high, arcuate at tip. Capsule horizontal, slightly curved, oblong, \pm 3.1 × 1.12 mm. Peristome perfect hypnoid with 2 to 4 cilia.

Distribution East Nepal, Sikkim, Bhutan (all in alpine heights), S.E. Tibet, Yunnan, Japan, Sakhalin, Siberia, Caucasus, Europe (incl. G.B.), Canada, U.S.A. (across northern States). Widespread in arctic North Hemisphere

DIPLOLEPIDEAE. HYPNOBRYALES. RHYTIDIACEAE. RHYTIDIUM

96. Rhytidium rugosum (Hedw.) Kindb.

Dioicous. Robust, yellow-green, often glossy plants in loose, wide mats. Main stem ascending or creeping, very thick, up to 12 cm. long, with irregular pinnate, short branches. Leaves dense, often wavy tip, plicate, branch feaves \pm 2.5 \times 0.77, stem leaves also oblong-lanceolate but single, covering more than half the leaf length. Leaf cells linear (elongate rhomboid at tip). Costa μ at tip, \pm 45 \times 7 μ below, lower leaf cells have their tips extended into papilli rendering the leaf leaves narrow, upper ones appressed to stem. Seta slender, erect, arcuate at top, \pm 3 cm. high 2 cilia. Paraphyllia not present. Pseudoparaphyllia in branch axils only

Distribution: Garhwal, East Nepal & Bhutan (at alpine heights), S.E. Tibet, Yunnan, Setschuan, Japan, Siberia, Central Asia, Caucasus, Europe (incl. G.B.). Canada, Northern U.S.A., Arizona, New Mexico, Mexico, Morocco, Central & South Africa. A widespread species but more restricted to the Northern Hemisphere.





96. Rhytidium rugosum (Hedw.) Kindb.

BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: RHYTIDIACEAE: RHYTIDIADELPHUS

97. Rhytidiadelphus triquetrus (Hedw.) Warnst.

Very robust, yellow-green plants in large, thick, loosely intertangled mats. Main stem stout and stiff but elastic, with weak central strand, ascending or quite erect, branching unequal and irregular pinnate, not in one plane, bushy, up to 15 cm. long; pseudoparaphyllia only in branch axils. Stem leaves very large ($\pm 5.7 \times 2.2$ mm.), glossy, highly plicate Branch leaves smaller ($\pm 3.5 \times 1.34$ mm.). Leaves acute at tip from a cordate-auriculate, decurrent base, widely spreading (shrunk but still spreading in the lower leaves), margin denticulate at leaf tip. Costa double, unequal, reaching 3/3 leaf length. Leaf cells linear narrow rhomboid, $\pm 35 \times 6~\mu$ at top, $\pm 55 \times 5~\mu$ at lower leaf. Basal cells wide ($\pm 38 \times 9~\mu$) at base. Basal cells are highly porose. There is a row of smaller ($\pm 19 \times 9$ μ) cells at extreme base but alar is not differentiated. Back of upper leaf is scabrous by spinose papillose development of cell tips. Sporophytes on main (usually erect) stem. Dioicous. Perichaetial leaves with spread out narrow tops, sheathing below. Seta slender, erect, ±3 cm. long, arcuate at tip. Capsule horizontal to drooping, $\pm 3.2 \times 1.8$ mm., smooth or widely striate when dry. Operculum conical apiculate. Peristome normal hypnoid, ± 0 65 mm, high, cilia 3.

Distribution. Western Himalaya, Bhutan, China, Japan, Sakhalin, Siberia, Turkestan, Caucasus, Europe (incl. G.B.), Canada, Northern U.S.A. (south up to Missouri), Central Africa. A North

DIPLOLEPIDEAE: HYPNOBRYALES: HYLOCOMIACEAE: HYLOCOMIUM

98. Hylocomium splendens (Hedw.) B.S.G.

Dioicous Robust, yellow-green (brownish below), stiff, widely spreading plants. Main stem procumbent, reaching 20 cm. or more, branching bi- or tripinnate in one plane (frondose), proliferating every year by an annual innovation growing from the middle of last year's growth, central strand absent. Main stem with numerous green, subulate paraphyllia. Leaves somewhat glossy, patent to spreading (appressed to stem with raised tips when dry), concave, cordate-lanceolate, at least partly scariose (by cell tip expansions) on back. Stem leaves large (\pm 3 \times 1 mm.), abruptly narrowed into a long, flexuose acumen, costa short double. Branch leaves smaller (\pm 1.4 \times 0.6 mm.), acumen short; margin denticulate almost to base, costa double, short but proportionally longer, the longer one covering more than half the leaf. Leaf cells narrow rhomboid, $\pm 42 \times 7~\mu$ (border cells wider), cell tips with papillose expansion. Cells along extreme base large (\pm 38 \times 19 μ), irregularly rectangular, orange, with one extra row on top at alar. Leaves on new year's branch primordium (L_{B-2}) very short (\pm 0.64 \times 0.2 mm.), appressed to stem, ecosrate. Sporophytes on main branches. Perichaetial leaves on top erect and sheathing. Seta slender, erect or ascending, ± 3 cm long, bent or arcuate at top. Capsule inclined to horizontal, ovate-oblong, \pm 1.92 \times 1.28 mm. Operculum conical, rostrate. Peristome normal, hypnoid.

Distribution: East Nepal, Bhutan, Tibet, China, Japan, Kuriles, Central Asia, Caucasus, Europe final. Arctic & G.B.), Azores, Tunis, Algeria, Central Africa, Greenland, across Canada and U.S.A. (south up to Colorado), West Indies, New Zealand. All over Northern Hemisphere extending down





BRYIDAE: ARTHRODONTEAE DIPLOLEPIDEAE: HYPNOBRYALES: HYLOCOMIACEAE: MACROTHAMNIUM

99. Macrothamnium macrocarpum (Reinw. & Hornsch.) Fleisch.

Dioicous. Robust, yellow-green to golden, somewhat glossy plants. Main stem wiry, creeping by annual stoloniferous growths, central strand weak, secondary stems ascending, simple but some large bi- or tripinnate, frondose. Leaves - (1) on main stem somewhat spreading, wide-based triangular (L_s), plicate, up to 0.9×0.77 mm., cordate, narrowed below, acute on top; (2) leaves on primary branches (L_{B-1}) larger $(\pm 1.1 \times 0.77 \text{ mm.})$, cordate, narrowed below, acute on top; (3) leaves on branches of higher order (LR2) progressively smaller but of same shape as the lowest branch leaves. Margin denticulate. All leaves with short double costa. Leaf cells narrow rhomboid; apical cells ±50 × 6 µ, the extreme tip cell and two marginal row cells slightly broader, basal leaf cells ±77 x 7 u; tips of leaf cells except those at base are extended into small papilli. Alar not differentiated but the lowest basal row is formed by $\pm 38 \times 9 \,\mu$ cells. Sporophytes on main stem Perichaetial leaves narrow with subula-like serrated top, erect. Seta slender, erect, up to 5 cm. long, arcuate at top. Capsule horizontal, curved cylindrical, $\pm 4 \times 1.34$ mm. Operculum conical. Peristome perfect hypnoid with about 4 cilia.

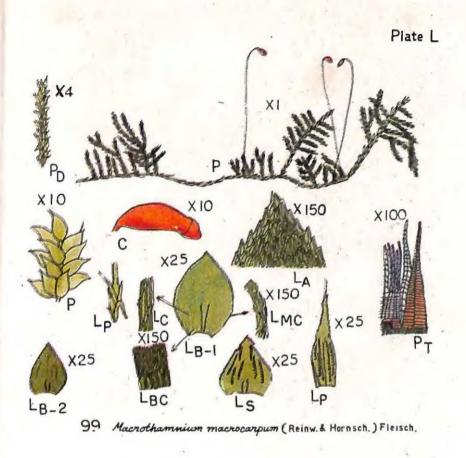
Distribution: Kumaon, East Nepal, Sikkim, Darjeeling, Bhutan, Arunachal, Upper Assam, Khasia, Nilgiri, Palni, Ceylon, Burma, Thailand, Sumatra, Java, Borneo, Philippines, Taiwan, Yunnan, Japan, Hawaii. A wide-spread Indo-Pacific species.

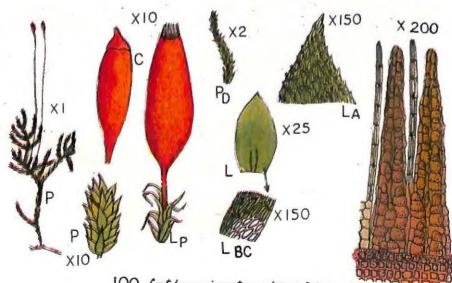
DIPLOLEPIDEAE: HYPNOBRYALES: HYLOCOMIACEAE: LEPTOHYMENIUM

100. Leptohymenium tenue (Hook.) Schwaegr.

Fairly robust, rigid, brownish green, glossy plants in dense-tufts. Main stem creeping wiry. Secondary branches ascending or erect, semi-dendroid by further pinnate branching. Branches bare at base, densely leafy above. Leaves patent to somewhat spreading (appressed to stem and imbricate when dryl, oblong-ianceolate to ovate-lanceolate, $\pm 1.47 \times 0.74$ mm., concave, apex short acute apiculate, margin dentate at apex. Costa short double. Leaf cells linear rhomboid, $\pm 38 \times 7$ μ , cell tips raised into papilli in the upper leaf; alar differentiated by $\pm 19 \times 11.5 \,\mu$, irregularly rectangular, hyaline cells; cells at leaf insertion also irregularly rectangular and wide. Sporophytes on principal branches. Seta erect, slender, 2.5 to 3 cm. long. Capsule erect, symmetrical, ovatecylindrical, 3 × 1 to 1.5 mm. Operculum conic, short rostrate. Annulus not differentiated. Exostome teeth usually very irregularly formed on back; endostome segments linear with a median slit. Spores 22 to 30 µ.

Distribution: Mussoorie, East Nepal, Sikkim, Darjeeling, Bhutan, Khasia Hills, Naga Hills, Burma, Yunnan, Thailand, Southeast Asia & Mexico.





100. Leptohymenium tenue (Hook.) Schwaegr.

